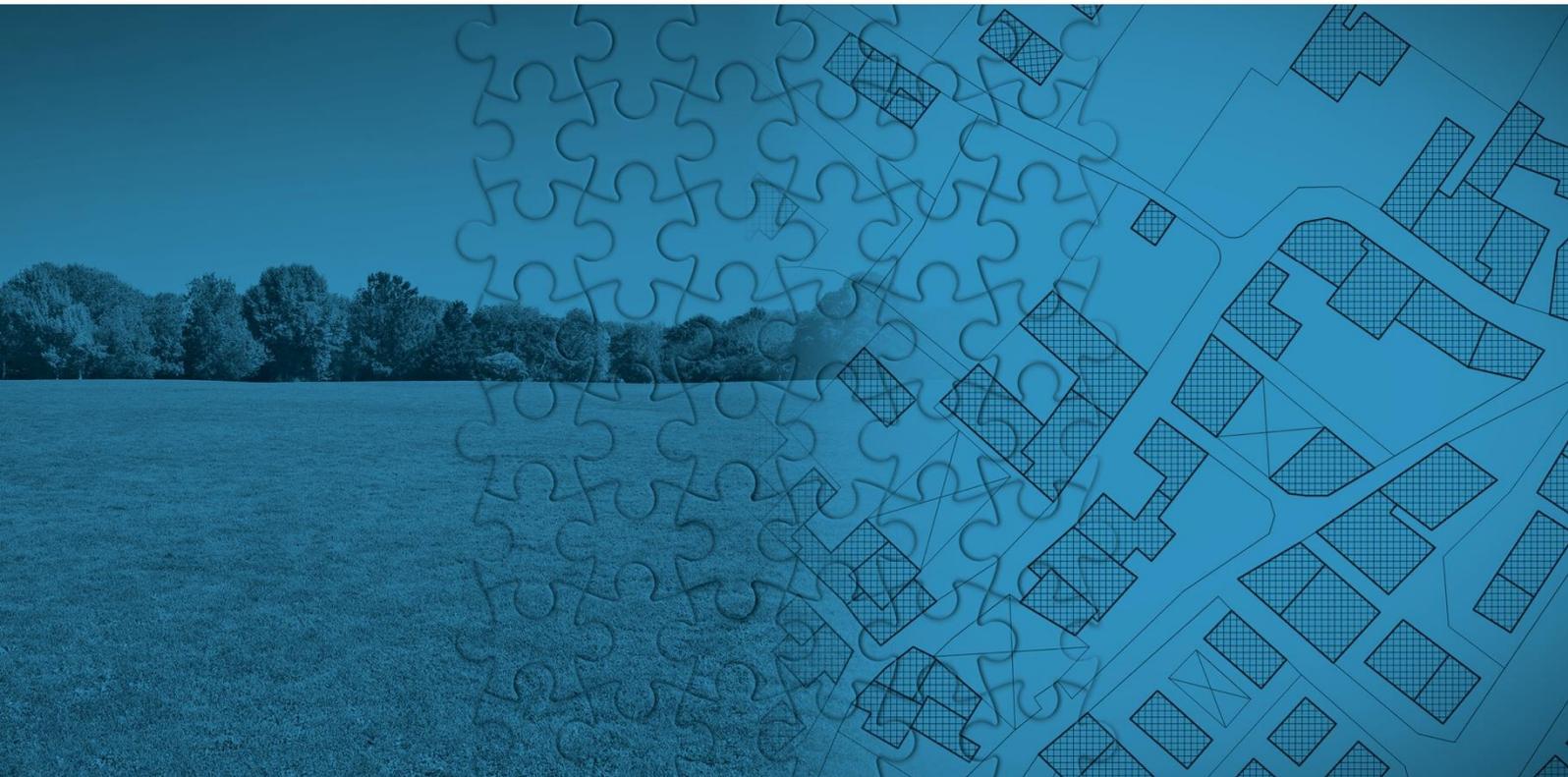


[Template]

Socio-Economic Impact Assessment

World Bank Implementation Methodology



Credits

This template has been prepared by the World Bank Urban, Disaster Risk Management, Resilience and Land Global Practice' (GPURL), Land and Geospatial Team, and supported by the Korea Green Growth Trust Fund.

The World Bank team was led by Kathrine Kelm, Senior Land Administration Specialist, Land and Geospatial Team, and included Andrew Coote, Dr Lesley Arnold and Dr Robin McLaren.

The concepts for the methodology are based on the Integrated Geospatial Information Framework (IGIF), which was adopted by the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM), August 2018.

The World Bank Methodology was developed in conjunction with the Food and Agriculture Organization of the United Nations.

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Instructions

This document is a template for reporting the results of analyzing how the fundamental geospatial data¹ might be optimally applied to assist in the delivery of key Government policies. This alignment is designed to ensure that the Spatial Data Infrastructure (SDI) delivers more efficient government, economic growth, citizen benefits and sustainable development.

This document provides headings, instructions, standard content, and examples that are recommended for the Socio-economic Impact Assessment (SEIA):

- *[Template] – On cover page to be overwritten with Country name*
- *Country Logo - Add to cover page*
- *[Country] – Bracketed text is to be overwritten*
- *Headings – are included to assist in structuring the content and shaping the report.*
- *Instructions – are shown in purple italics and are to be deleted once understood.*
- *Standard Content – is content, shown in black text, which is to be retained/included in each Country Action Plan.*
- *Examples – are shown in grey as a guide to the content of each section and are to be overwritten with new material or removed as required.*
- *Remember to update the Table of Contents page numbers and Figure and Table caption numbering and references.*
- *Also update the Abbreviations to those relevant to this document.*

The report should be “packaged” together with other deliverables, principally as the cost-benefit spreadsheet, on publication. The packaging will usually take the form of a zip file to ensure that appropriate versions of each deliverable are synchronized.

This section can be deleted in its entirety once the instructions are understood.

¹ Definition and Scope of UN GGIM Fundamental Data Themes – see Annex A
http://ggim.un.org/meetings/GGIM-committee/8th-Session/documents/E-C20-2018-7-Add_1-Global-fundamental-geospatial-data-themes.pdf

Status

This version of the template is final. It has been prepared by the World Bank following the publication of IGIF Part 2 in August 2020.

Add short statement to indicate clearly to the reader its status e.g., internal, draft, final. Check if a disclaimer is also required.

| Report: Version history | | | |
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| Version | Date | Author(s) | Remarks |
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ABBREVIATIONS

The table below should provide common abbreviations. It should be updated to reflect what is relevant for each country and circumstance. All other abbreviations should be spelt out in full in the text on their first usage.

| | |
|------|--|
| API | Application Programming Interface |
| BCR | Benefit to Cost Ratio |
| CGE | Computable General Equilibrium |
| CBA | Cost-benefit Analysis |
| CORS | Continuously Operating Reference Station |
| CPF | World Bank Country Partnership Framework |
| DT | Diagnostic Tool |
| FAO | (UN) Food and Agriculture Organization |
| FTE | Full Time Equivalent |
| GAPD | Geospatial Alignment to Policy Drivers |
| GDP | Gross Domestic Product |
| GI | Geospatial Information |
| GIS | Geographic Information System |
| GNSS | Global Navigation Satellite System |
| IGIF | Integrated Geospatial Information Framework |
| IMF | International Monetary Fund |
| IRR | Internal Rate of Return |
| ISO | International Standards Organization |
| KPI | Key Performance Indicator |
| NGO | Non-Government Organization |
| NMA | National Mapping Authority |
| NPV | Net Present Value |
| NSDI | National Spatial Data Infrastructure |
| NSO | National Statistical Office |
| OECD | Organization for Economic Co-operation and Development |

| | |
|---------|---|
| OSM | OpenStreetMap |
| ROI | Return on Investment |
| SDG | Sustainable Development Goal(s) |
| SDI | Spatial Data Infrastructure |
| SEIA | Socio-economic Impact Assessment |
| TA | Technical Assistance |
| ToR | Terms of Reference |
| UNDP | United Nations Development Program |
| UNEP | United Nations Environment Program |
| UN-GGIM | United Nations Global Geospatial Information Management |
| WB | World Bank |

ACKNOWLEDGEMENTS

This report was prepared at the requested of [Name of Commissioning Agency].

The team was led by [name of team leader] and included [names of team members].

The team is grateful to the [title of head of commissioning agency], for their direction and hospitality and for putting together a support team which helped in organizing stakeholder meetings and collecting and collating data at both sector and higher-level government institutions.

The team also expresses their sincere gratitude to the wide range of stakeholders from different Ministries and Agencies, private sector organizations and Non-Government Organizations (NGOs) who gave valuable insights, information and time.

A full list of the parties engaged in the production of this report is included as Appendix A.

PREFACE

This is a common introduction to all templates within the IGIF World Bank methodology. Please check for updates prior to publication.

The world is experiencing a fourth industrial revolution built upon the internet and a comprehensive data infrastructure of fundamental datasets². The term infrastructure is used here in the same sense as the road network is part of the fundamental infrastructure required to support transportation.

To help achieve this transition, many countries are building national data infrastructures. For instance, the Netherlands has been at the forefront of recognizing that integrating authoritative key data registers, such as buildings, addresses and ownership, into a coherent data infrastructure will, not only make Government more cost-effective, but will also make the interaction for citizens and businesses with Government quicker and more efficient³ and allow the private sector to derive benefits from new services.

One of the primary components of a data infrastructure is the location of a nation's assets, including land, natural resources and the built environment to allow these assets to be managed more effectively in the context of development planning and climate change mitigation, for example. This is because "everything happens somewhere" and without knowledge of location (geospatial position⁴), decision making on many matters of national importance is significantly impaired.

The term Spatial Data Infrastructure (SDI) has historically focused on the collection of data and the implementation of technologies. The IGIF provides guidance on how to extend the scope of SDI to cover the governance, policy, financial, capacity and engagement processes necessary to collect, maintain, integrate and share geospatial information, through all levels of government and society.

In August 2020, the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM) adopted the Integrated Geospatial Information Framework (IGIF), which provides the strategic guidance that enables sub-national or national-specific Action Plans to be prepared and implemented to strengthen integrated information management.

The IGIF aims to assist countries (including city and regional governments) to move towards e-economies, e-services, and e-commerce. Delivering socio-economic value by improving services to citizens, enhancing evidence-based government decision making processes, creating new job opportunities, facilitating private sector economic growth, and taking practical actions to achieve a digital transformation. Through these means, the IGIF will help

² United Nations GGIM Fundamental Geospatial Data Themes: https://ggim.un.org/documents/E-C20-2018-7-Add_1-Global-fundamental-geospatial-data-themes.pdf

³ <https://business.gov.nl/regulation/addresses-and-buildings-key-geo-register/>

⁴ These terms are used in different geographies and contexts and are regarded here as interchangeable.

to bridge the geospatial digital divide between developed and developing countries and to support the 2030 Agenda for Sustainable Development.

IGIF Structure

The IGIF comprises of three (3) parts as separate, but connected, documents:

- **Part 1:** Overarching Strategic Framework presents a forward-looking Framework built on national needs and circumstances, focusing on policy, perspectives and elements of geospatial information. It sets the context of 'why' geospatial information management is a critical element of national social, economic and environmental development.
- **Part 2:** Implementation Guide is the detailed document that provides the 'what', the specific guidance and actions to be taken in implementing the Framework. The aim is to provide guidance for governments to establish 'nationally' integrated geospatial information frameworks in such a way that transformational, albeit staged, change is enabled, visible and sustainable.
- **Part 3:** Country-level Action Plans will provide templates and guides to operationalize the Framework in a national and sub-national context. Providing the 'how, when and who' approach, this document will assist countries to prepare and implement their own country-level Action Plans taking into consideration national circumstances and priorities.

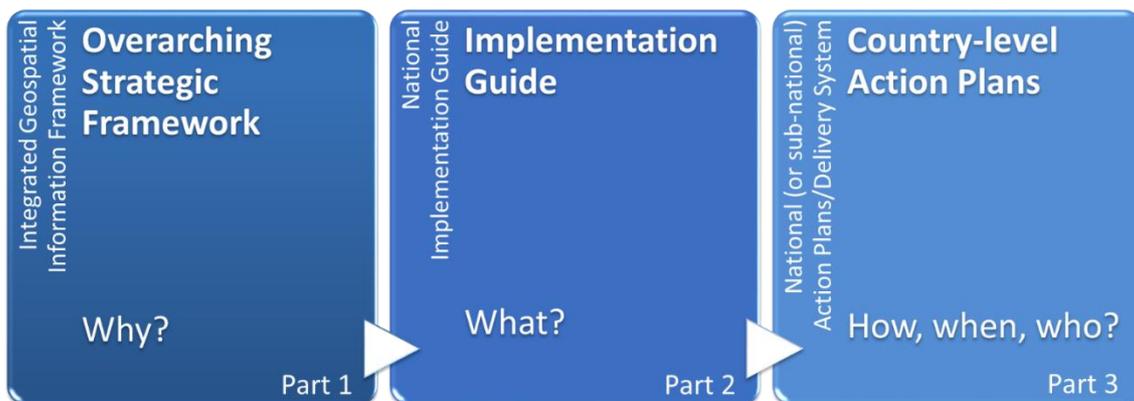


Figure 1: The 3 component documents of the Integrated Geospatial Information Framework

World Bank IGIF Implementation Methodology

The World Bank Group has established an IGIF Implementation Methodology and corresponding analytical toolkit to support the use of the IGIF and incrementally create SDIs customized to specific countries and priorities. The graphic below illustrates the sequence and relationship of these analytical tools used to arrive at the implementation of the SDI. The symbology shows the analytical tools (in orange), key inputs (in blue), the IGIF in purple, outcomes (in green) and uses arrows to different types of information flows.

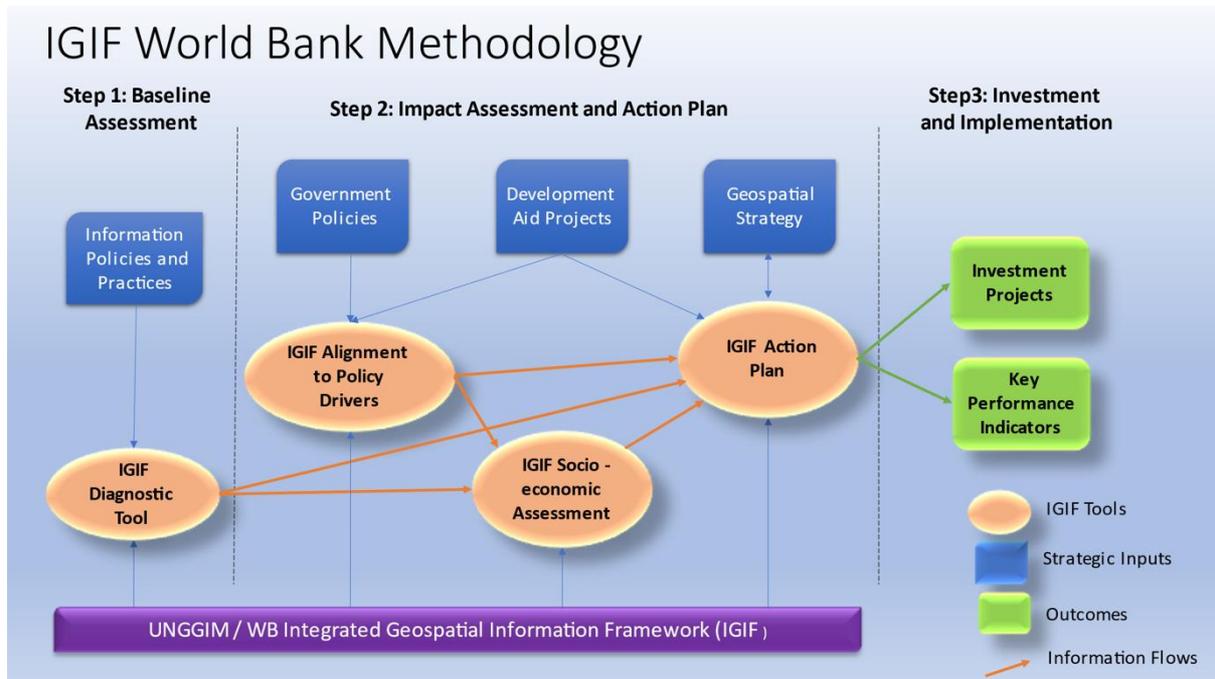


Figure 2 World Bank IGIF Implementation Methodology

In summary, this methodology has been applied as follows:

Step 1: Baseline Assessment

A single integrated tool is used for this purpose:

Analytical Tool 1 - IGIF Baseline Diagnostic Tool (DT): this provides an assessment of the “as is” position of geospatial information management in the country, structured around the nine IGIF pathways, including governance, policy, financial, human capacity, and technical perspectives. The output forms a baseline for the next steps.

Step 2: Impact Assessment and Action Plan

Three tools are used to build a prioritized, cost-justified roadmap for strengthening integrated geospatial information management:

Analytical Tool 2.1 - IGIF Alignment to Government Policy Drivers: this tool is used to align the Government’s strategic objectives and international commitments to specific spatial use cases (applications) and then prioritizes them based on how well they support and accelerate achieving these strategic objectives.

Analytical Tool 2.2 - IGIF Socio-Economic Impact Assessment: this tool delivers an assessment of the socio-economic business case for investment in an SDI from both qualitative and quantitative perspectives. It is informed by the outputs from the two tools outlined above.

Analytical Tool 2.3 – IGIF Action Plan: this tool builds on the previous deliverables to create or update a high-level geospatial strategy and a corresponding costed roadmap for SDI enhancements, presented as a series of interdependent policy interventions and implementation projects.

Step 3: Investment and Implementation

Once the Action Plan has been approved in terms of scope, investment plan and priorities, then work will commence to identify sources of government and international funding. Individual actions may also need to be specified in greater detail to support implementation planning and the definition of Key Performance Indicators (KPIs) to monitor and evaluate implementation.

These steps must be delivered within a recognized project management methodology that provides appropriate governance and incorporates transparency and accountability for all tasks and outcomes.

DOCUMENT STRUCTURE

To be modified if additional sections are required.

The rest of the document is structured as follows:

- **Section 1: Context** - a brief overview of the customer (city, region, or nation), its recent history, particularly related to geospatial information and related infrastructure. It also describes the purpose of undertaking the socio-economic impact assessment at this time. Achievements to date in the field of geospatial information and SDI development are described.
- **Section 2: Scope** – outlines the objectives of the SDI, target outcomes, priorities and contribution of the economic analysis and its contribution to the Investment and Action Plan.
- **Section 3: Methodology** – sets out the case for cost-benefit analysis and how it has been applied.
- **Section 4: Literature Review** – examines national-scale studies focused on the economic benefits of geospatial information.
- **Section 5: Analysis** – describes the impacts identified during the study and the process used to quantify a subset of the more significant benefits.
- **Section 6: Economic Impacts** – presents the cost-benefit analysis results and sensitivity analysis for potential variations from the expected return on investment
- **Section 7: Next Steps** - summarizes further development that is required to finalize the work

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EXECUTIVE SUMMARY

i. Background

The central purpose of this report is to assess the economic, social and environmental impacts⁵ of creating a SDI⁶ for [Country] and, where possible, quantifying the net benefits. It adopts the World Bank methodology developed under the Global Geospatial project and United Nations guidelines for implementing an IGIF⁷ on which the SDI will be built.

The results of the analysis will feed into an action and investment plan outlining where policy and project interventions will generate the most significant positive social impacts and stimulate economic growth. Unfortunately, there is a shortage of case studies, or agreed methodologies, for quantifying and attributing benefits of the creation of an SDI, particularly for developing countries. In chapter 0, we present a literature review of some of the most relevant existing studies, noting these are small in number. We therefore also borrow from other related disciplines in order to adopt good practice.

ii. Current State

One to two paragraphs of highlights drawn from Baseline Assessment concerning the current state of SDI development in the territory.

⁵ The term impacts is adopted throughout this section to acknowledge that there may be drawbacks from the interventions proposed, so these may be positive as well as negative in financial terms.

⁶ National Spatial Data Infrastructure (NSDI) is the policy, capacity building, technical and economic activities necessary to create the required location (spatial) information to underpin social and economic development.

⁷ IGIF Overarching Strategic Framework: <http://ggim.un.org/meetings/GGIM-committee/8th-Session/documents/Part%201-IGIF-Overarching-Strategic-Framework-24July2018.pdf>

iii. Alignment of Geospatial Information Priorities to Government policy

The overall target outcome for the SDI is to lead to the efficient, equitable and optimal utilization and management of geospatial information applied across all sectors of the economy. To ensure optimal alignment, the study has analyzed a wide range of Government policies and commitments. Based on this analysis, the following sectors are those where, it believes, geospatial information generally and the SDI particularly, can make the most significant and positive impact:

List the sectors identified in the Geospatial Alignment to Policy Drivers (GAPD), which typically may include:

- (a) Land*
- (b) National and Sectoral Development Planning*
- (c) e-Government*
- (d) Transport*
- (f) Disaster and Emergency Management*
- (g) Agriculture (including Forestry)*
- (h) Water*
- (i) Energy*
- (j) Environment and Tourism*
- (k) Maritime*
- (l) Defense*
- (m) Health*

iv. Investment Profile

The investment required is composed of core data and technology projects with supporting governance, legal, financial management, partnership development and human capacity building measures. It will deliver an SDI composed of [xx] foundation themes of data that are nationally complete, authoritative, up to date and to an appropriate quality to underpin development of the economy of [Country] and facilitate improving the welfare of its people.

The specific investments include:

List the main components of the investment scenario proposed, the following list is illustrative.

- Development of a **National Basemap System** (data model, software and hardware) to acquire, manage, disseminate and sustain the NSDI data themes;

- **Completion of the Land Cadastre;**
- Creation of a single integrated **National Geoportal** to facilitate **online access to all national geospatial information** for citizens, businesses and professionals as commensurate with cyber-security and commercial constraints such as intellectual property;
- Agreement of **Geospatial data sharing** protocols to reduce costly data duplication and improve quality and consistency;
- Integrating existing registers to create a **National Geocoded Street Address database;**
- Data acquisition to create a **3D City Model** for city centers;
- Facilitating **wider access to Satellite Imagery;**
- Prioritized program of **Data Quality improvements** to mapping and other foundation data themes designed to meet a wide range of national needs over the foreseeable future;
- Ensuring the update of the geodetic network including complete coverage of **Continuously Operating Reference Stations (CORS) and positioning services;**
- Establishing a **Geospatial Disaster Risk Management System;**
- Integrating **spatial analysis and visualization capabilities into National Statistics;**
- Creating a **Geospatial Centre of Excellence** in order to create the resource capacity to sustain the SDI for the long-term.

Provide a summary of the costs in local currency and US\$.

These investments would be completed within a (investment period) at an estimated cost of XX local currency (USD equivalent)⁸.

Key to success of this initiative will be the active participation of a wide range of stakeholders from both public and private sectors to ensure maximum cross-cutting benefits are realized. It is envisaged that it would be coordinated, and the program of projects managed, by [designated body] as the lead state body for land administration and geospatial information, however, investment will be spread amongst the stakeholders.

v. Geospatial Use Cases

From face-to-face interviews with [number of stakeholders engaged], including Government Ministries, agencies, State-owned enterprises and private sector companies, the team identified over [xx] applications (use cases) where there are demonstrable benefits from the implementation of Geographic Information Systems (GIS) technology requiring foundation geospatial data⁹ that an SDI and enhanced land administration would provide. These positively impact many sectors including:

⁸ State exchange rate to US\$, when obtained and source.

⁹ Foundation Data Themes: http://ggim.un.org/meetings/GGIM-committee/8th-Session/documents/E-C20-2018-7-Add_1-Global-fundamental-geospatial-data-themes.pdf

List here the titles of all use cases by sector (copied directly from use case inventory).

Those impacts that were identified but could not be reliably quantified are documented in narrative form as supporting evidence in section 5.3 of this report. A full list of use cases is also included in the Geospatial Alignment to Policy Drivers Report.

vi. Selective Benefits Quantification

As is commonly observed across the developing world, there is not necessarily the data or the understanding of the financial impacts amongst suppliers or users, to build a fully comprehensive justification for investment.

It is also important to note that both the benefits and investments detailed in this report are based on the available data collected in a short timeframe. The absence of specific line-item investments or benefits for a ministry does not mean that no action is required, rather it reflects the data we were able to collect and quantify. The team expects that other quantified use cases, and the investments required to realize these benefits, would yield comparable benefit to cost ratios to those detailed below.

To overcome these limitations, the team has sought to quantify a subset of the most significant impacts for a small number of use cases, documented in section [6.4.1]:

Examples may include the following:

1. **Improved geospatial data sharing** – reducing the costs to the collection and maintenance of geospatial information by the creation of a single master source that is authoritative, complete and current with both an Application Programming Interface (API) for automated system-level interoperability and simple Graphical User Interface for casual users. A national geocoded address dataset is seen as a potential early exemplar of effective sharing.
2. **Better Disaster Management** – through a fully operational geospatial system that will reduce levels of damage from being able to respond to natural disasters more rapidly and efficiently.
3. **Faster Emergency Dispatch** – availability of fundamental data, particularly a full national geocoded address database and updated geographical names, including points of interest.
4. **Improved collection of Land Use fees and taxes** – through more accurate mapping of land use.
5. **Higher Property Tax Revenues** – by using geocoded addresses and detailed base map data (including 3D city models) to infer accurate market valuations at the level of individual properties.
6. **Land market growth** – by improving availability and transparency of land for sale and providing better security of tenure through reliable registration.

7. **Enhanced Urban Planning** – through the availability of more accurate and current base maps allowing quicker impact studies and greater citizen understanding of new developments.
8. **New Geospatial products and services** – based on availability through the SDI of more comprehensive and open foundation data from which the private sector can build new businesses and foster innovation.
9. **More efficient and cost-effective land surveys** - through availability of CORS (GNSS) real time positioning services covering all parts of the country.

The estimated impact of each of these use cases are shown in the Table below.

Table 1 Summary of Quantified Benefits

| Ref | Impact | Evidence | Methodology | Benefit Recipients | Net Discounted Value of Benefits \$mil | |
|-----|--|--|---|--------------------|--|-------|
| 1 | National geospatial data sharing (addresses) | Cost estimates and current data duplication | Multiplier effect of information sharing | Govt | | 4.5 |
| 2 | Reduced Loss and Damage during Disasters | Substantial Case Study Expert predictions of reduced costs for future Forest Fires, weather and other natural disasters | Reasoned extrapolation from case study, statistics and expert opinion | Indirect | | 33.2 |
| 3 | Faster emergency response in case of building fires, leading to reduced damage | Statistics supplied by SRO. Global Geospatial Value studies | Reasoned estimation of potential savings, backed by expert opinion. | Indirect | | 5.4 |
| 4 | Increased land use fees and taxes | Current revenues Volumes where premium rates apply | Estimation of proportions of land where premium rates of fees or taxes apply | Revenue | | 26.6 |
| 5 | Increased collection of Property Tax | WB Study in [City Council] | Predictions of increased revenues for City Council | Revenue | | 2.6 |
| 6 | Land Market Growth | Current real estate market size, Comparable study in Bulgaria | Local market analysis, validated by recent comparative study | Indirect | | 3.5 |
| 7 | Urban Planning efficiencies from 3D City Model | In-depth EuroSDR study for Republic of Ireland | Benefits Transfer, validated by local expert opinion | Govt | | 2.6 |
| 8 | Growth in geospatial products and services | Global Economic Value Study for geo-services | Scaled to [Country] and validated based on current size of [Country] ICT market | Indirect | | 6.2 |
| 9 | Open geospatial data value to improving government efficiency | Comparative study of value of geospatial before and after introduction of open data in Denmark | Benefits transfer from Danish study, scaled to [Country] economy | Indirect | | 11.9 |
| 10 | GNSS Densification reducing data acquisition costs | Local expert opinion Australian economic study | Local market intelligence, validated by Australian study | Indirect | | 18.3 |
| | TOTAL US\$ | | | | | 114.7 |

vii. Cost-benefit Analysis

These estimated impacts have been fed into a Cost-benefit Analysis (CBA) model, to provide an “order of magnitude” assessment in financial terms of the Return on Investment (ROI). The cash flow forecast is shown in the chart below and detailed in section [6.4.2] of the report.

Add chart extracted from Cost-benefit Analysis to replace example (from [Country]) below:

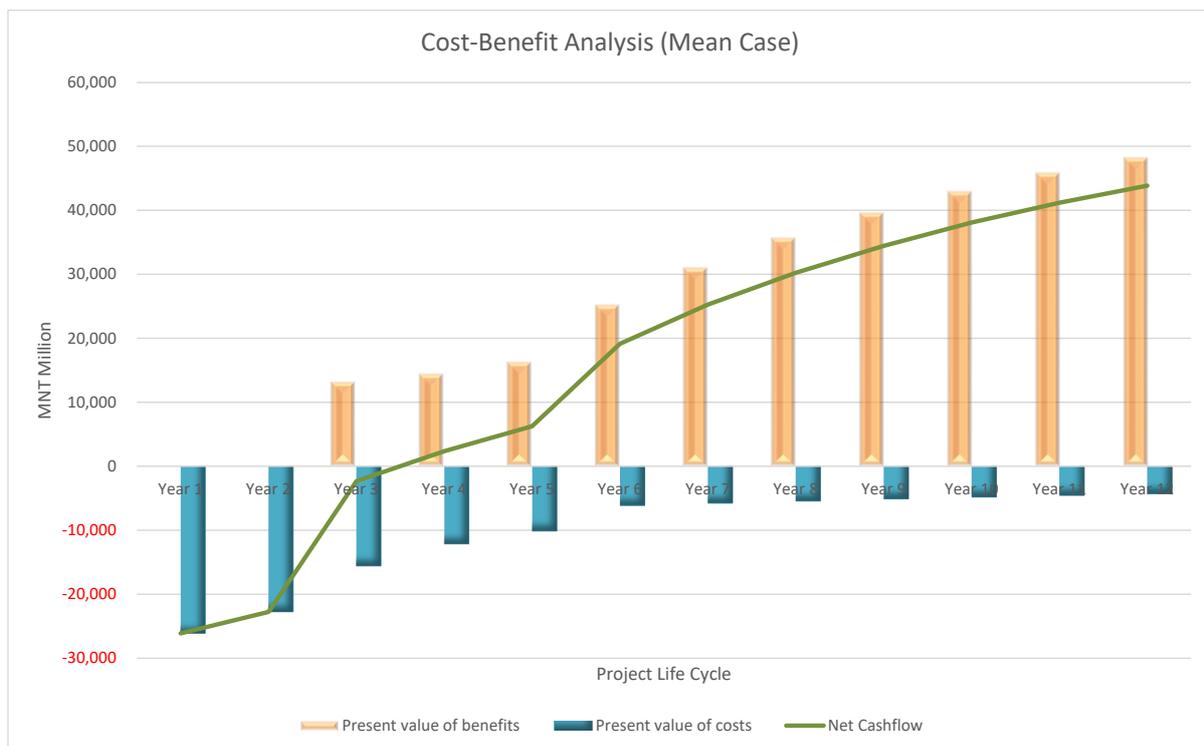


Figure 3 Cost-Benefit Forecast (Mean Case)

Add Statement explaining what can be concluded from the chart e.g., impact of quick wins where benefits realized before end of investment period.

Benefit – Cost Ratio:

Net Present Value:

Optional Limitation Statement: *It is important to stress that this assessment is based upon quantification of xx% of the identified use cases. If data and time were not constrained, and more case studies had been quantified, it is our expert opinion that the calculated ROI would be significantly higher.*

viii. Sensitivity Analysis

Sensitivity analysis, to assess the robustness of the cost-benefits analysis, was conducted by making the following changes to the mean case outlined above:

- i) For the lower bound (most conservative) benefit estimate, low bound impacts were used for all those quantified cases where ranges were available, as follows:

Add use case references and the reasons for reduction to net benefits.

- *Statement on resulting metrics:*
- *Benefit to Cost Ratio: xx (reduction of xx% on mean case)*
- *Net Present Value: xx (reduction of xx on mean case).*

- ii) For the upper bound (optimistic case), we have applied the upper bound range of values for the same set of use cases as used in the lower bound.

Add use case references and the reasons for reduction to net benefits.

- *Statement on resulting metrics:*
- *Benefit to Cost Ratio: xx (increase of xx% on mean case)*
- *Net Present Value: xx (increase of xx on mean case).*

Statement on conclusion from sensitivity analysis. Optional wording - we conclude that the policy advice that this is viable investment would not change even in the lower bound case.

ix. Report Status

Description of status (e.g., draft for review, final) describing outstanding actions drawn from the section on Next Steps.

1. CONTEXT

1.1 Global Context

The world is experiencing a fourth industrial revolution as we transition to what is dubbed the information age. This revolution is built upon the internet and an infrastructure of fundamental datasets. The term infrastructure is used here in the same sense as the road network is part of the fundamental infrastructure required to support transportation.

To help achieve this transition, many countries are building national information infrastructures. One of the primary components of a data infrastructure is the location of a nation's assets including land, natural resources, the built environment; the results of high impact processes such as climate change and urban planning; and events, such as flooding. This is because "everything happens somewhere" and without knowledge of location (or spatial position) decision making on many matters of national importance is significantly impaired. We use the term SDI as a "short-hand" for the policy, capacity building, technical and economic activities necessary to create the required location (spatial) information to underpin social and economic development.

It should be stressed that an SDI does to include all geospatial data. The United Nations has defined a set of 14 foundation geospatial data themes¹⁰.

Add graphic showing the themes included in the infrastructure for this specific territory, including those added specifically to meet local needs.

In August 2020, the United Nations Committee of Experts on UN-GGIM adopted the IGIF, which provides the strategic guidance that enables country specific action plans to be prepared and implemented. Direct benefits will include encapsulating new and innovative approaches to national geospatial information management, implementing integrated evidence based decision-making solutions and maximizing and leveraging national information systems that are tailored to individual country's situations and circumstances.

The Framework aims to assist countries to move towards e-economies, e-service and e-commerce to improve services to citizens, build capacity for using geospatial technology, enhance informed government decision making processes, facilitate private sector development, take practical actions to achieve a digital transformation and to bridge the geospatial digital divide in the implementation of national strategic priorities and the 2030 Agenda for Sustainable Development.

The IGIF comprises of three (3) parts as separate, but connected, documents:

¹⁰ UN GGIM Foundation Data Themes http://ggim.un.org/meetings/GGIM-committee/8th-Session/documents/E-C20-2018-7-Add_1-Global-fundamental-geospatial-data-themes.pdf

- **Part 1:** Overarching Strategic Framework presents a forward-looking Framework built on national needs and circumstances, focusing on policy, perspectives and elements of geospatial information. It sets the context of ‘why’ geospatial information management is a critical element of national social, economic and environmental development.
- **Part 2:** Implementation Guide is the detail document that provides the ‘what’, the specific guidance and actions to be taken in implementing the Framework. The aim is to provide guidance for governments to establish ‘nationally’ integrated geospatial information frameworks in such a way that transformational, albeit staged, change is enabled, visible and sustainable.
- **Part 3:** Country-level Action Plans will provide templates and guides to operationalize the Framework in a national and sub-national context. Providing the ‘how, when and who’ approach, this document will assist countries to prepare and implement their own country-level Action Plans taking into consideration national circumstances and priorities.

This document presents an initial socio-economic impact assessment, based on the IGIF, for development of an SDI over a 5-year period. It is a key analysis to guide the development of the Action Plan for [Country].

1.2 Brief Country Description

Short description of country –drawn from previous IGIF reports.

1.3 Climate

Only if relevant to socio-economic assessment.

1.4 Administrative Structure

This should particularly explain the structure and functions of key Ministries and subdivisions of local government.

1.5 Economy Breakdown

Description of breakdown of the economy by sector in terms of Gross Domestic Product (GDP) contribution.

It should describe those sectors that represent the biggest percentages of the economy. The figure below illustrates the preferred format using the figures from [Country].

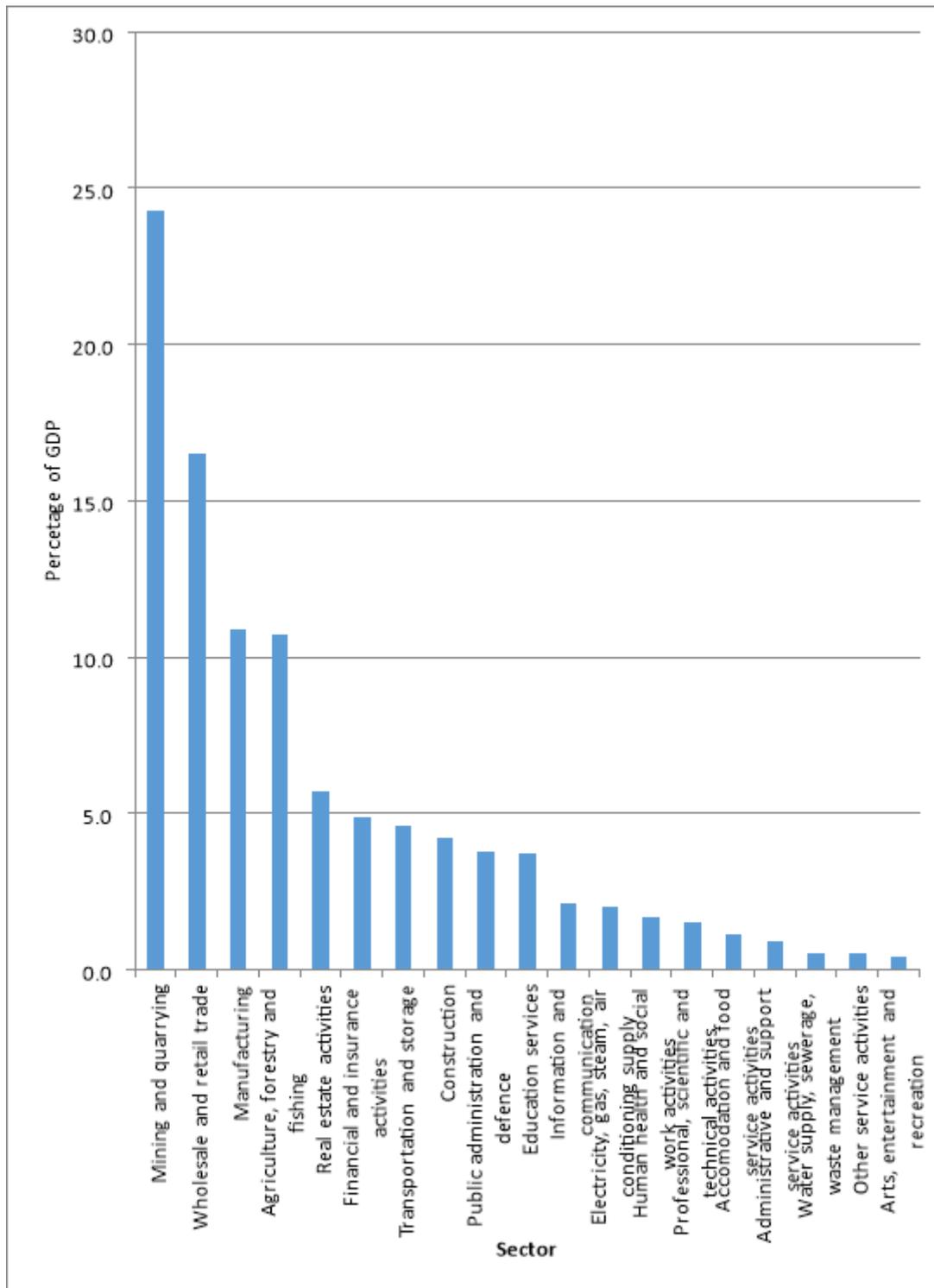


Figure 4 GDP Sector Breakdown (National Accounts (2018))

2. SCOPE

2.1 Objectives

The central objective for the study team is to assess the economic, social and environmental benefits of creating an SDI and, where possible, quantifying these benefits.

Add any specific objectives agreed with customer here.

The results of the economic benefits analysis will then feed into a costed action plan outlining where policy and project interventions will generate the most significant positive social impacts and stimulate economic growth.

The work will take advantage of the United Nations IGIF Part 1¹¹ and can, as a result, serve as an example to other countries and regions embarking on developing Action Plans.

2.2 Target Outcomes

Based on achieving these objectives, the SDI is expected to lead to the efficient, equitable and optimal utilization and management of land resources. This, in turn, would have a positive impact on many parts of the economy, including:

Modify this list to suit subject of assignment.

- *Creating new job opportunities particularly in the ICT sector but also in real estate, retail and financial services.*
- *Improved public sector efficiency – of institutions responsible for land administration, property taxation, spatial planning, transport and agriculture.*
- *Citizen benefits – through increased efficiency in road navigation, emergency services dispatch and improved interactions with the public sector, particularly in respect to land transactions and property taxation.*
- *Greater private sector investment – particularly in stimulating the land market and facilitating infrastructure development.*
- *Adapting to climate change through reductions in carbon emissions from vehicles, improving flood risk assessment and resilience to disasters.*

2.3 Economic Drivers

Outline the position in the economic cycle, including fiscal balance, inflation rate (including what is driving inflation) and central bank policy interest rate. Explaining the current views on upside and downside risks to the economic outlook is also helpful, a good source of such

¹¹Integrated Geospatial Information Framework <http://ggim.un.org/meetings/GGIM-committee/8th-Session/documents/Part%201-IGIF-Overarching-Strategic-Framework-24July2018.pdf>

information is the International Monetary Fund (IMF) which produces regular country assessments.

Fiscal policies which determine likely appetite for investment in information infrastructure should then be summarized. Any mention at this level of priorities for investment such as digital transformation, land reform or climate change are particularly useful “anchors” for the investment plan description that follows.

2.4 Strategic Investment Priorities

The study has analyzed a series of Government policies which set out its plans for strategic investment. Based on this analysis and aligning with the economic drivers as outlined above, the following sectors are those where, it believes, geospatial information generally and the SDI particularly, can make the most significant and positive impact:

Summary list of priorities, an illustration of content from previous good practice follows:

- (a) **Land Administration including state land management**, valuation, land and property taxation and land use planning.
- (b) **National and Sectoral Development Planning** – adopting a holistic approach, balancing economic diversification and social needs across all aspects of the urban and rural built environment and need to meet Sustainable Development Goals (SDG).
- (c) **eGovernment** – including e-governance, to optimally leverage digitalization opportunities to make the state more efficient and reduce the burden on citizens in all interactions with public services.
- (e) **Transport** – extending the network of paved roads, introducing intelligent transport systems that integrate alternative modes, including rail and air.
- (f) **Disaster and Emergency Management** – improving planning and response to all types of incidents.
- (g) **Agriculture** – matching the need to improve food security whilst avoiding over-exploiting the carrying-capacity of the ecosystems.
- (h) **Utilities** – providing access to water, electricity, heating, and telecommunications necessary to the welfare of citizens and development of business.
- (i) **Environment and Tourism** – protecting the environment and attracting more visitors to the country.
- (j) **Defense** – underpinning the security of the country.
- (k) **Health** – Supporting epidemiological studies, social research, and health care, as well as for decision-making contributing to the formulation of health-related policies and monitoring and managing the outbreaks of disease.

In addition, the priorities identified will need to support economic growth and yield practical and quality of life benefits to citizens.

2.5 Links to existing Donor Programs

There may be existing projects already being advanced by the Government with support from aid agencies (such as UN Development Program, USAID, Japan International Cooperation Agency and many others) or development banks (World Bank or other relevant International Financial Institutions, that are relevant to the project.

These should be summarized, with focus on their complementarity to (or duplication with) the SDI. The most significant project should include a paragraph description, whilst others that are peripheral should be covered in one or two sentences under an “other Projects” heading. All should include references to web or other resources.

- *List projects*
- *other*

2.6 Sustainable Development Goals

It is envisaged that the economic analysis will also facilitate preparation of more informed country action plans to support the 2030 Sustainable Development Goals, see Figure 5. Figure 5

Figure 5 Relevance of NSDI in Reporting on SDGs

3. METHODOLOGY

The purpose of undertaking the analysis is to establish the economic justification for the project, guide prioritization of investments, position the value of SDI in a wider socio-political context and create an economic baseline against which future progress can be compared.

3.1 Analytical Tools

There is no need here to include a detailed description of the tools as this has been covered in the preface, what follows is a brief description of the tools and the place of this report within the methodology.

The study team are following the SDI implementation methodology, developed by the World Bank and United Nations Food and Agriculture Organization (FAO), which is aligned with the IGIF. It consists of four analytical tools:

- i) **SDI Diagnostic:** assessment of the “as is” position of spatial infrastructure in the city including data, policy, financial and capacity perspectives.
- ii) **Geospatial Alignment:** mapping Government policy drivers (strategic objectives) to spatial use cases, prioritizing by effectiveness and identifying data needs.
- iii) **Socio-economic analysis:** to establish costs and benefits of the proposed policy and process interventions, including applying new technology and global best practice for developing countries.
- iv) **National SDI Action Plan:** guided by the results of analysis under (i) - (iii), create a roadmap for SDI enhancements, presented as a series of interdependent policy interventions and implementation projects.

This approach is represented diagrammatically below (Figure 6).

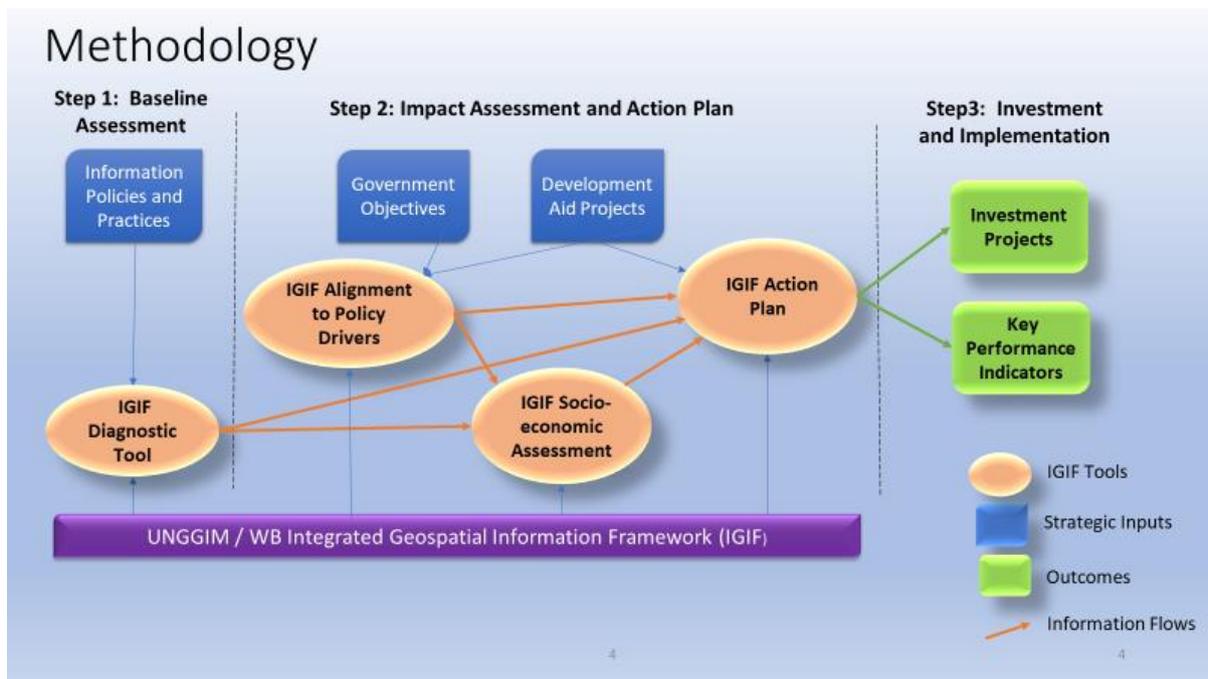


Figure 6 World Bank SDI Methodology

This report focuses on the outcomes of applying tool (iii).

3.2 Context

This section positions the study and sets out any overall limitations to the analysis.

It is challenging to undertake a detailed economic analysis at this early stage of the technical appraisal, when a full description of the interventions to be funded in the [Country] Action Plan, has yet to be agreed.

Further, there is a lack of case history of quantifying and attributing benefits for either improving institutional structures in land administration or the creation of an SDI, particularly for developing countries.

For these reasons this economic analysis focuses on the most significant impacts that can be readily associated with directly expected outcomes and quantified. CBA is the methodology most suited to representing such an analysis in financial terms. Those impacts that were identified but could not be reliably quantified are included in narrative form as supporting evidence.

It is envisaged that as the SDI develops, this analysis will be revisited and refined through detailed business cases for components of the Action Plan.

3.3 Approach

Here should be an overview of the approach adopted to the SEIA including any limitations and assumptions. Some standard wording is included.

In developing countries, there is lack of comprehensive statistical data concerning “horizontal” components of economy such as geospatial information and systems. This necessitates the use of a range of techniques to estimate and triangulate the impacts of a program such as creating an SDI.

In this case, interviews with [xx] stakeholders from public and private sectors were undertaken during [state period of study] in order to assemble as much primary evidence as possible in the time available. A mix of traditional methods of building case studies, garnering expert opinion and benefits transfer have been employed.

4. LITERATURE REVIEW

Add Introductory statement, the words that follow are optional.

Two types of studies were reviewed to help leverage best practice, firstly in terms of the economic analysis approach by reviewing recent relevant World Bank material and then secondly, national scale economic and financial studies for investment in geospatial information.

4.1 Economic Reports

The following are some of the most relevant research reports reviewed in the process of undertaking the analysis. They have been selected for their relevance to the subject matter and approach to economic analysis adopted in this study. Major studies, particularly those used to infer socio-economic impacts, should be given a paragraph of description.

4.2 World Bank Doing Business

This is a particularly influential report, in which every country is reviewed by the World Bank on an annual basis.

4.3 United Nations Human Development Index

Used by aid agencies to categorizes all countries into high, medium or low income which determines eligibility for various levels of grant aid and loan interest rates.

4.4 Economic impact of National Spatial Data Infrastructure

Introductory statement, the standard words on the relative lack of studies covering developing countries should be used. Other comments specific to the scope of the study can be optionally added.

There are relatively few studies of the economic value of SDI. Those that do exist are confined to a few developed countries and because of inconsistency in scope are not directly comparable. For instance, some attempt to cover all impacts of geospatial information for a nation whilst others have a more limited scope in terms of the sectors of the economy assessed. Furthermore, there is no commonly agreed methodology for quantification.

This section summarizes some of those studies that have been undertaken and published in recent years and also includes a recent meta-analysis of return on investment in geospatial data and systems.

The examples reviewed should be updated to reflect recent economic benefit studies relevant the territory being studied.

4.4.1 Natural Resources Canada (2015)

Commissioned by Natural Resources Canada and published in 2015, the Canadian Geomatics Environmental Scan and Value Study¹² is one of the most comprehensive studies undertaken. The scope is described as providing findings from all lines of enquiry related to the economic and non-economic benefits associated with geomatics technologies and services in Canada. In Canada, geomatics is taken to include all geospatial information activities, rather than the narrower land surveying context used in most other geographies.

The report was based upon a review of the literature and the input received during consultations with Geospatial Information (GI) suppliers in industry and government, users of GI products and services, and providers of GI education and training programs. Selected case studies were also conducted with users of GI.

It considered three groups of socio-economic impacts:

- Geomatics Products and Services: this is the value in the Canadian economy of the provision of geomatics products and services (i.e., supply side).
- Economic Productivity: this is the value in the Canadian economy of the use of geomatics products and services (i.e., demand side). The impact that geospatial

¹² Link to study: <https://www.nrcan.gc.ca/earth-sciences/geomatics/canadas-spatial-data-infrastructure/cgdi-initiatives/canadian-geomatics>

information has had on the Canadian economy was estimated using a Computable General Equilibrium (CGE)¹³ model.

- Social and Environmental Benefits: these are the social and environmental benefits of the use of geomatics products and services that are difficult to quantify in economic terms.

The quantifiable results were estimated for 2013 as:

- A supply-side impact of about 2,450 private sector geomatics firms contributing CAN \$2.3 billion to the Canadian economy;
- A demand-side impact from the use of geospatial information of CAN\$20.7 billion – or 1.1% of national Gross Domestic Product (GDP);
- Generating approximately 19,000 jobs to the Canadian economy.

4.4.2 Ordnance Survey Ireland (2014)

The study titled ‘Assessment of the Economic Value of the Geospatial Information Industry in Ireland’¹⁴ looked at the value added to the Irish economy, the number of jobs generated by the GI industry and the savings delivered by that industry to the public sector. The project was undertaken by Indecon, an Irish-based economic analysis company. The first section of the report assesses the direct supply-side contribution to the economy, using market survey results and interviews with experts, as follows:

- Revenue from sales of GI related products/services of €117.5 million;
- Total value of exports of GI products/services of €18.9 million;
- Number of Full Time Equivalent (FTE) employees 1,677;
- Expenditure on wages and salaries of €84.4 million;
- Expenditures by suppliers of geospatial information on non-labor inputs of €48.2m.

The above was used to estimate a gross value added for the sector in Ireland to be €69.3m.

The second section of the report attempts to quantify the demand-side impacts. It identifies significant or very significant benefits arising from using GI and potential externalities from a market survey, as follows:

- Public and private sector cost savings: estimated public sector cost savings at €82 million per annum.
- Economic value of journey time savings:
 - Private cars: €94.26 million per annum.
 - Commercial vehicles: €185.81 million per annum.

¹³ Smart A, Coote, A. Economic and Financial Modelling of the Impact of Geospatial Information - Techniques and Results for land administration in developing Nations. World Bank, Land and Poverty Conference 2017

¹⁴ Link to study: <http://www.osi.ie/About-Us/Ireland-GIS-Economic-Report.aspx>

- Benefits to consumers of intensifying competition: estimated at €78m - €130m per annum.
- Wider impacts on innovation were not quantified.

4.4.3 The Economic Impact of Geospatial Services (2017)

A report commissioned by Google¹⁵ clearly demonstrates that the application of geospatial information has significant benefits outside of the traditional geospatial domain. It estimates worldwide and regional benefits for consumers (commuting and fuel efficiency, personal safety and purchasing efficiency), private industry (new products and services, productivity benefits, sales growth particularly for small businesses and tourism spend) and wider societal benefits (job creation, traffic congestion, urban planning, civic engagement, public health, safety & emergency response, disaster preparation and responsiveness, environment and wildlife preservation, knowledge creation and human capital development).

It is one of the few economic surveys to use a “willingness to pay” survey to calculate value. This is an effective technique particularly when attempting to estimate consumer benefits. The infographic below provides a summary of the major findings.

¹⁵ The Economic Impact of Geospatial Services, AlphaBeta, September 2017, <https://www.valueoftheweb.com/reports/the-economic-impact-of-geospatial-services/>

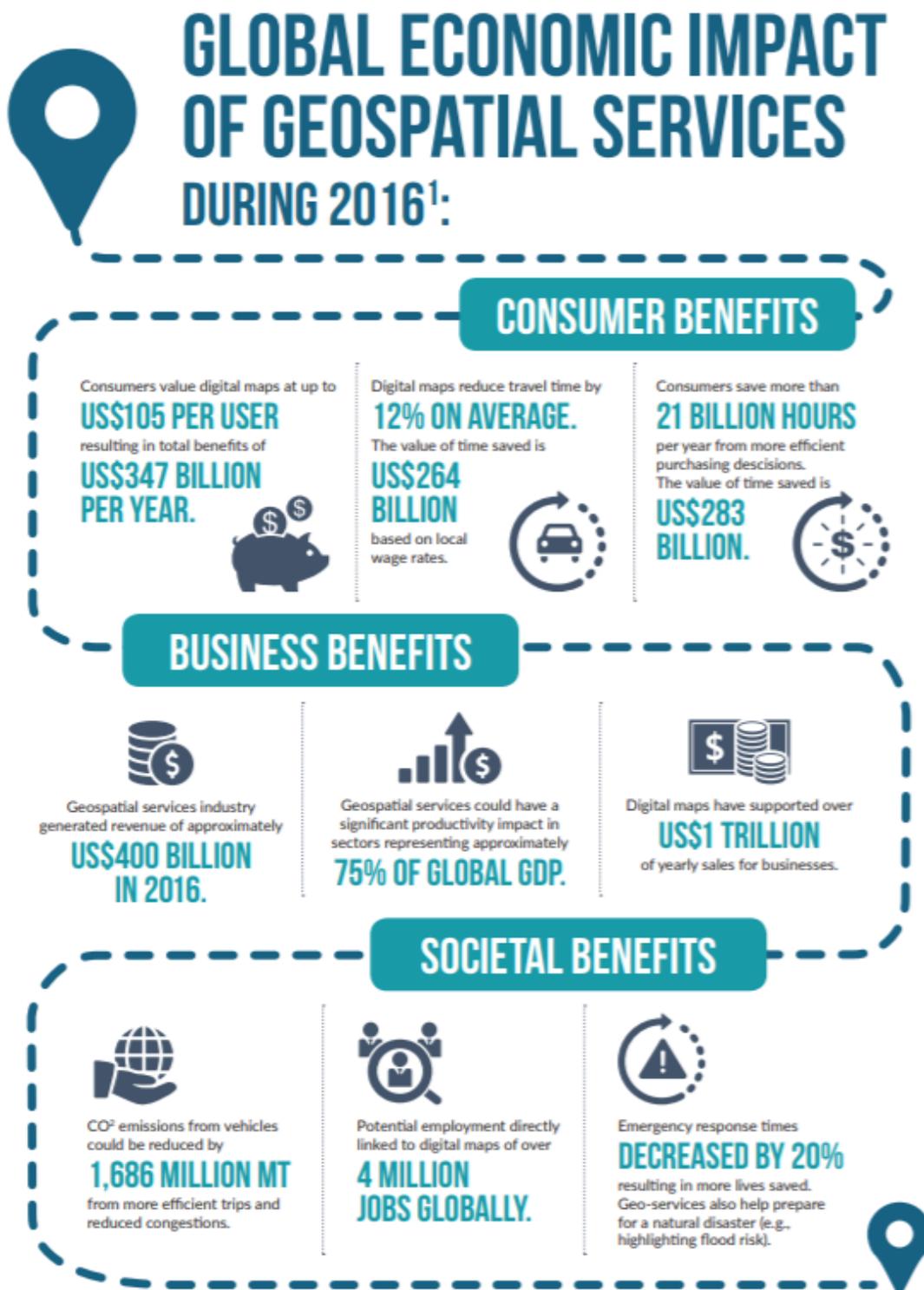


Figure 7 Summary Infographic AlphaBeta Study

4.4.4 Unlocking the Value of Geospatial Data (2018)

The study looks at how key parts of Ordnance Survey’s (OSGB) highly detailed OS MasterMap are being made completely open under the Open Government License, with the remaining

data being made freely available up to a threshold of transactions. This work will release £130m pa of economic value.

Making OS MasterMap available in this way is based on addressing the barriers identified through user research with, in particular, start-ups and small businesses. This research with both current and potential users of OS MasterMap identified four major barriers to its use:

- Price (complexity and cost).
- Licensing (complexity and restrictiveness).
- Ease of use (discoverability, interoperability and mechanism of delivery).
- Derived data (complexity and restrictiveness).

By addressing these barriers to use, these changes will enable businesses of all sizes to access not only OS's high-quality data, but to also geospatial data more widely to unlock economic value. In particular:

- Significantly more geospatial data will be fully open for businesses and developers to use, free and without restriction.
- Start-ups will be able to deliver new products and services with the data using the free threshold.
- Some businesses will not need to pay at all for their use of OS data because of the use of the free threshold.
- New innovations will be possible in the housing market — for example, this data will make it easier for property developers to identify potential development sites that aren't currently registered.
- New users will be able to understand the pricing structure for the data more easily following the OS changes removing uncertainty around cost of use.
- An improved errors and omissions tool and reporting process, and publication of data in additional formats will further improve the quality of the data and its ease of use.

4.4.5 Return on Investment Global Meta-Analysis (2015)

A recently published study titled “A Meta-Analysis on the Return on Investment of Geospatial Data and Systems: A Multi-Country Perspective¹⁶” looks at return on investment based on mainly cost-benefit studies and attempts to explain some variations across 82 cost-benefit assessments undertaken between 1994 and 2013. Multivariate regression methods are used to assess the size, significance and direction of individual effects. The results suggest that regional factors have the largest impact on the profitability of GI. Returns in Australia and New Zealand, for example, are four times larger than in Europe. In addition, small-scale regional investments have a 2.5 times lower return than large-scale international investments. Overall, the expected benefits of GI investments are approximately 3.2 times larger than the costs.

¹⁶ Trapp, N et al in Transactions in GIS, 2015, 19(2): 169–187

The observed increase in return for larger-scale investments is significant in the context of this paper since it indicates that the national approach to SDI now being adopted in Albania is likely to yield a better return than the “project-based” investments that have previously characterized geospatial investment in the past.

5. ANALYSIS

The results of the assessment are presented as a CBA, which is a very mature and widely recognized methodology for appraising large scale investment projects, often involving public spending. The process involves estimating the costs and benefits of a given program to establish whether the outcome at the end of the period of investment and operation represents a satisfactory ROI. The ROI may be compared to other potential investments, facilitating more objective prioritization.

CBA uses a process referred to as *discounting*, which involves accounting of the rate of interest which could have been earned had the funds used for investment been deposited in an interest-bearing account or other investment. The discount rate must be deducted from the estimated gains from a project, because the funds could have earned interest without incurring the same risk.

Restate exchange rate between local currency, which should be used as the primary measure and US\$.

5.1. Key Financial Variables

To be updated to cover best local or international practice:

- i) Life Cycle – a 12-year period, consisting of 5 years of investment followed by 7 years of use, this is commensurate with the infrastructural nature of the investment but taking into account the increasing pace of technological change considering any longer period increases uncertainty to unacceptable levels.
- ii) Discount rate set at 6% per annum, this is the current yield on government bonds net of inflation i.e., the rate at which the Government borrows money.
- iii) Inflation is assumed to have an equal effect on costs and benefits and neutral in accounting terms, so inflation effects are not considered in the model.

5.2. Investment Plan

The investment required is composed of core data and technology projects with supporting governance, legal, financial management, partnership development and human capacity building measures. It will deliver an SDI composed of the fundamental themes of data that are complete, authoritative, up to date and to an appropriate quality to underpin development of the economy and facilitate improving the welfare of citizens. The specific projects include:

List the main components of the investment scenario proposed, the following list is illustrative.

- Development of a **National Basemap System** (data model, software and hardware) to acquire, manage, disseminate and sustain the NSDI data themes.
- **Completion of the Land Cadastre.**
- Creation of a single integrated **National Geoportal** to facilitate **online access to all national geospatial information** for citizens, businesses and professionals as commensurate with cyber-security and commercial constraints such as intellectual property.
- Agreement of **Geospatial data sharing** protocols to reduce costly data duplication and improve quality and consistency.
- Integrating existing registers to create a **National Geocoded Street Address database.**
- Data acquisition to create a **3D City Model** for city centers.
- Facilitating **wider access to Satellite Imagery.**
- Prioritized program of **Data Quality improvements** to mapping and other foundation data themes designed to meet a wide range of national needs over the foreseeable future.
- Ensuring the update of the geodetic network including complete coverage of a CORS network and **positioning services.**
- Establishing a **Geospatial Disaster Risk Management System.**
- Integrating **spatial analysis and visualization capabilities into National Statistics.**
- Creating a **Geospatial Centre of Excellence** in order to create the resource capacity to sustain the NSDI for the long-term.

Provide a summary of the costs in local currency and US\$.

These investments would be completed within a [investment period] at an estimated cost of [XX] local currency (USD equivalent)¹⁷.

¹⁷ State exchange rate to US\$, when obtained and source.

The investment plan is detailed separately in a series of excel spreadsheets packaged with this report and takes the costs of delivering each of these actions into account. It is subject to change as development of thinking on the Action Plan matures.

It is assumed that investment will be phased over a period of [xx] years. The investment profile (non-discounted values) is shown in Table 2.

Table 2 Provisional Investment Profile

| Period | Investment Value | Cumulative Investment Value | Investment Value | Cumulative Investment Value |
|----------|------------------|-----------------------------|------------------|-----------------------------|
| | Local Currency | Local Currency | US\$ | US\$ |
| Year 0+1 | | | | |
| Year 2 | | | | |
| Year 3 | | | | |
| Year 4 | | | | |
| Year 5 | | | | |
| Total | | | | |

There will on-going costs for maintenance of systems, refresh of geospatial data, capacity building and other assets created by the investment. **An allowance of [xx%] of the initial investment has therefore been made to ensure sustainability during the period of operation.** It is assumed this will be financed by the Government from savings realized as a result of the investment.

Additional operating costs are assumed will be met from within “business as usual” baseline costs of the participating agencies, similarly financed from the positive impacts of the investment.

5.3. Benefits Assessment

The assessment identified many potential impacts of the SDI, some direct and many indirect. These include both market benefits and non-market benefits. A list of over [xx] separate applications (use cases) identified during the study is summarized in section [6.4.1].

Based on the policy priorities outlined in section 5.3 and an assessment of the most significant impacts, the study team has attempted to quantify [xx] of these, as outlined in section 5.5.

5.3 Socio-economic Benefits

In following paragraphs, we outline some of the most significant socio-economic benefits. A full list of all use cases identified during the study is included in the **Geospatial Alignment to Policy Drivers (GAPD)** report.

Add a paragraph outlining the use cases by sector, examples follow:

5.3.1 eGovernment

The digitalization of Government, with the twin objectives of reducing the “friction” on citizens and business of dealing with public services and making Government more efficient, is a key component of the public policy. Although this already in progress, the current focus is rightly on creating a platform on which to build multiple services. The SDI initiative, will build on this platform by providing data to allow many more services to be made available through one stop shops. The specific use cases which will contribute to the successful digitalization include:

- Integration of cadastral parcel and land rights registers providing a more transparent, consistent and up to date database to underpin growth of the land market.
- Improving the efficiency of transactions between citizens and businesses, especially by having a single national address database augmented with geographic position.
- Enable the National Statistics Office (NSO) to undertake more sophisticated AI-based spatial analysis of census and other survey information.
- Enhancing the National Information Infrastructure with geospatial attributes, allowing questions that have a location dimension to be more easily answered.

5.3.2 Improve efficiency in the Water industry.

Geospatial information underpins the management of water supply and sewerage in many developed and developing countries. Relevant use cases include:

Improved Asset management – knowing the location of water supply pipes and sewerage systems is the starting point to improve many aspects of management. Position of assets are currently largely recorded on paper maps based on measurements made in relation to existing features typically road carriageway edges or buildings. Creating an accurate digital representation relies upon having accurate and up to date large scale topographic maps particularly where assets are underground. The SDI program will enhance the availability of current geospatial data enabling digitalization to be more accurate and converted more quickly, making it cost-effective.

Optimizing network maintenance – combining transport data with the asset management system reduces cost of maintenance by enabling the deployment to jobs more quickly. Further, records of work undertaken can also be recorded using mobile GIS allowing teams to spend more time on-site.

Easier Network design – digitalized location records enable design of extensions to the network to support new housing and commercial developments to be more reliably and quickly planned;

Tracking Water loss and leak management – it was estimated at as much as 40% of piped water is lost to leakage. A digitalized network will enable engineers using geospatial analysis to locate where water pressure is lower than expected given usage, allowing them to find where water loss is occurring. Further, when leaks and consequent flood incidents happen engineers will be able to more rapidly determine how to isolate pipe sections and stop the flow.

5.3.3 Health

Data collection – reporting of new cases, Intensive Care Unit (ICU) capacity and many other factors of the information model (see below) have a geospatial component. Most existing tools used for data collection in the health service lack the ability to record location data completely and accurately. A current example is recording of new cases and negative diagnoses in doctors' surgeries. Patient record systems may be paper based, and at best, digitally recorded addresses are in an unstructured form. The level of match of address to location, even in countries such as South Africa with relatively sophisticated geospatial systems is low. Consequently, the location of where a victim caught the disease cannot be ascertained with any certainty, so finding clusters and contact tracing is compromised. GIS can help doctors and patients to pinpoint locations, their home and other places they have visited, on a map or satellite image.

Situational Awareness – the dashboards that have been created by John Hopkins University¹⁸ and sites in individual countries and cities are very powerful tools for **visualizing** the current status of the disease spread and, when combined with predictive models (see below), what future patterns might look like. These are widely used by politicians and senior company executives to make decisions and to **improve community engagement** by more effectively sharing information with the public.

Predictive Analysis – the reproductive (R) value, that indicates how many other persons each corona positive individual might infect, is based on models that are inherently spatial, relying particularly on movement patterns of those individuals and others that they come into contact with. These models work currently on historical statistical predictions of movement integrating demographic, lifestyle and geospatial data. Working our way out of lock down will require near real time spatial data to allow epidemiologists to be able to enhance these models and better inform these decisions.

Another example of geospatial enhancement of existing tools is Penn Medicine's Predictive Healthcare Team, based in the United States which adapted its Susceptible, Infected, and

¹⁸ <https://coronavirus.jhu.edu/>

Recovered (SIR) mathematical model, to create a new model it calls CHIME (COVID-19 Hospital Impact Model for Epidemics). The CHIME model provides up-to-date estimates of how many people will need to be hospitalized, and of that number how many will need ICU beds and ventilators. It also factors in social distancing policies and how they might impact disease spread¹⁹, see Figure 8.

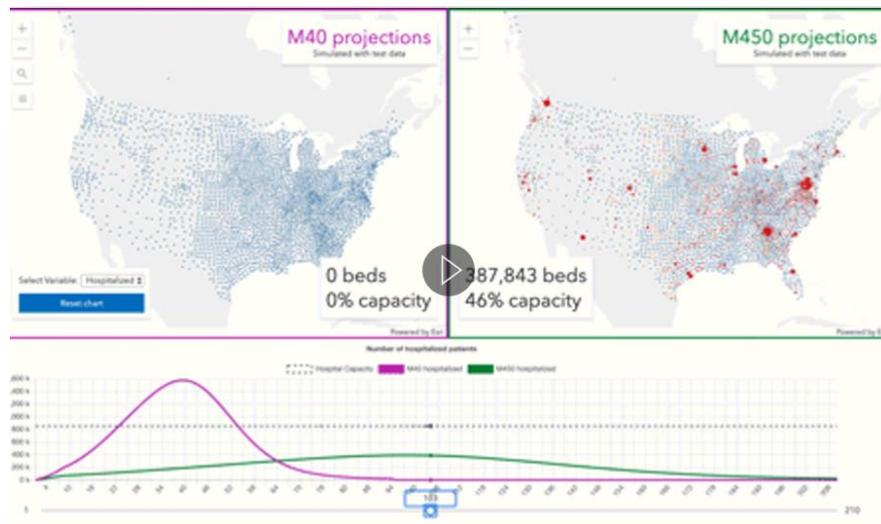


Figure 8 Hospital Capacity Prediction using CHIME

Demographic Analysis – understanding distribution of population is clearly an important ingredient to planning all components of response. The concentration of vulnerable, elderly and other “at risk” groups is key to shielding measures. Globally, such statistical data is increasingly widely geo-referenced as a result of global work to enhance census and socio-economic surveys.

Logistics – once demographic analysis has established the need, then meeting the requirement is a job for logistics planning. How do we most efficiently deliver food, care workers and Personal Protective Equipment to these communities, is a question which can be most effectively answered using road transport data and GIS network analysis algorithms. Improving the response to an emergency call by routing an ambulance to a hospital with capacity to deal with a patient can be literally a matter of life and death at times when the medical system is heavily loaded.

Allocation of Resources – the allocation of critical resources, such as medical staff with particular skills, to hospitals based on travel times is what the GIS community refer to as a location-allocation problem and has developed special tools for doing this type of analysis. Another of this class of problem addressed by geospatial solutions is site selection e.g., for field testing centers. They answer the question - where are the possible sites, such as large parking lots that could be easily converted for testing and which configuration of these in an

¹⁹ <https://www.esri.com/about/newsroom/blog/models-maps-explore-covid-19-surges-capacity/>

area will give the average shortest drive time for the largest number of those needing to be tested. This use case is illustrated in Figure 9.

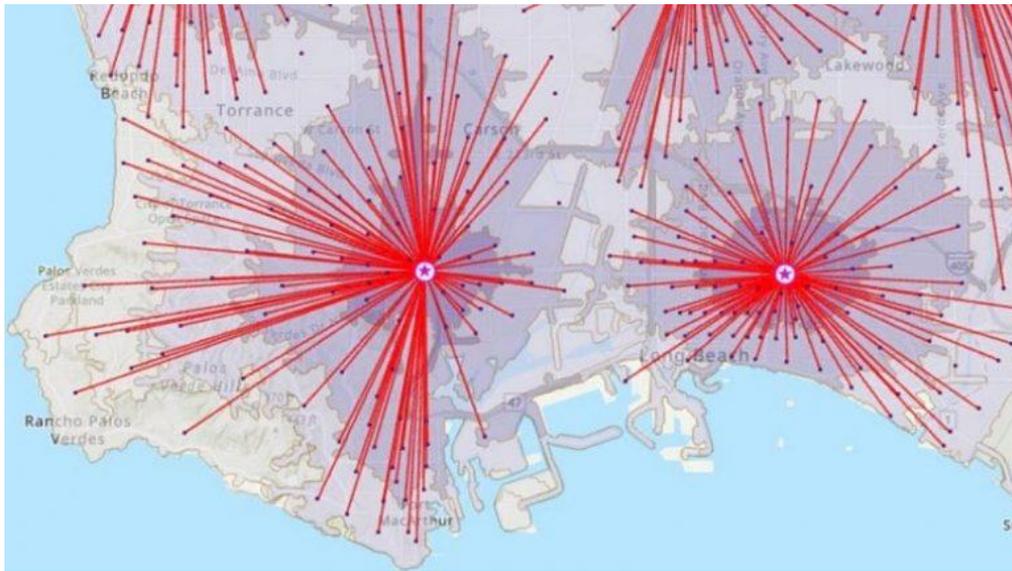


Figure 9 Location-Allocation model

Nearest Facility – this is the counterpart to the problem above. Once temporary facilities have been set up, how do I direct people to the closest one to their location. Apps that enable GIS network analysis performed on entry of a current location are readily available from many providers. Often these are enhanced by enabling timed appointments to be made through the same app.

Test, track, and trace is the term widely used for the techniques currently being considered in different countries for aiding the gradual releasing of lock down conditions. The concept is that you sign-up to an app which you install on your smartphone. If a person tests positive, based usually on answering a series of diagnostic questions within the app, then a series of alerts are cascaded to other persons who have been in your proximity. They will then be asked to self-isolate or follow other instructions from authorities. Work at the Oxford University Big Data Analytics center suggests that the approach helps to reduce the rate of spread, and the time it is necessary to spend in quarantine, even if the take-up of the app is relatively limited²⁰.

Many of this type of solution already introduced, such as in South Korea, rely on GPS for locating individuals via their smartphone. In Singapore, the Government has now made an open-source app they developed (Trace Together) for this purpose, freely downloadable.

Concerns being discussed with the use of GPS hinge upon location privacy and the protections that need to be put in place to prevent long-term storage and subsequent use of the data collected by Governments or private companies involved in processing and transmitting the data.

²⁰ Oxford University Big Data Institute <https://www.bdi.ox.ac.uk/>

Apple and Google have announced a joint initiative which uses the Bluetooth Low Energy (BLE) capabilities of modern smartphones to try to obviate some of these concerns. In their solution, Bluetooth logs when users are close to each other but is designed so that neither the individuals nor the app creators can find out the identity of those who have tested positive. However, there are concerns about the accuracy of BLE which can identify other devices in ranges of 2m to 30m depending on the intervening materials, so may present many false positives. Further, in developing countries the ownership of smartphones is limited and some older models do not support BLE.

5.3.5 Mining and Natural Resources

5.3.5 Education

5.3.6 Transport

5.3.7 Agriculture

5.3.8 Urban Planning

5.3.9 Tourism and Cultural Heritage

5.3.10 Environment

5.4 Quantified Market Impacts

Given the limited time available for the study and limitations on economic data availability, quantified impacts should be regarded as indicative of an “order of magnitude” ROI.

Some of the benefits identified are impacts. An externality is an economic term referring to a cost or benefit incurred or received by a third party. However, the third party has no control over the creation of that cost or benefit. An externality can be both positive or negative and can stem from either the production or consumption of a good or service²¹.

What follows here is an explanation of the case studies and the method of calculation of the impact (benefits and drawbacks²²) including assumptions and limitations.

The structure recommended is as follows:

- i) Use Case – this sets out in narrative form the impact.*
- ii) Quantification Methodology – the data and process of calculation of the net benefits (benefits minus drawbacks). Assumptions and limitations should be stated.*
- iii) Impact – summary of the calculation, concluding with the values used in the cost-benefit analysis.*
- iv) Links to Appendices or external documents supporting the case study.*

Two examples are included here from the [Country] SEIA to illustrate the structure and content of each report.

Improved Disaster Risk Management reducing loss of life and damage to property and agricultural Production.

5.4.1 Emergency management

Emergency management at a national level in [Country] is coordinated by the National Emergency Management Agency (NEMA) and encompasses a wide range of activities ranging from responding to natural disasters such as earthquakes, severe weather events or flooding to human-caused disasters. Accurate, timely and relevant geospatial information is critical in all aspects of emergency management: planning, mitigation, preparedness, response and recovery phases. During an actual emergency it is critical to have the right data, at the right time, displayed logically, to respond and take appropriate action.

Examples of the use of geospatial data and systems for emergency management include: hazard mapping for flood plains, identifying potential landslip susceptibility, defining of areas prone to severe weather events, tracking the location and supply of support and rescue

²¹ Investopedia definition - <https://www.investopedia.com/terms/e/externality.asp>

²² An example of a drawback is that if legal cases are reduced by improved land registration, then there are less land law-related cases, so the legal profession earns less fees.

teams, identifying hot-spots in forest fires in order to tackle them more effectively and assisting with ongoing updates on damage assessment and recovery.

The geospatial information, such as addresses and topographic mapping, necessary for the emergency management system could be obtained from other sources, such as Google and OpenStreetMap (OSM). These sources are already loaded into the initial system for some areas. An SDI would provide comprehensive, consistent, current and authoritative data for the whole country, which cannot be replicated from these sources. However, the counterfactual of Google and OSM must be factored in to reduce the benefits anticipated.

We examine one case in more detail here, forest fires.

We look at the potential savings in terms of area lost and economic value of that area by the more effective use of geospatial information by NEMA. During our recent visit, NEMA demonstrated to the study team their current geospatial system based on ArcGIS. They indicated that they had capacity issues in terms of hardware / software infrastructure and training which was preventing the full operational rollout of the system.

Quantification Methodology:

This was been assembled in three parts.

- i) Budget requirements to fully operationalize the current system

NEMA provided a budget to operationalize their current system (Phase 1 and Phase 2 combined). This is based on software, hardware and training requirements. Please note that we have not verified the requirements.

Table 3 Operationalizing NEMA Geospatial System

| Description | Funding Requirement MNT (Million) | Funding Requirement US\$ |
|-------------|-----------------------------------|--------------------------|
| Phase 1 | 283 | 105,000 |
| Phase 2 | 323 | 120,000 |
| TOTAL | 606 | 225,000 |

- ii) Economic costs of forest fires.

The FAO estimates that Mongolia loses around 200,000 ha of productive forest land annually due to forest fires²³. This estimate is confirmed by geospatial data available from the Ministry of Environment and Tourism EIC geoportal²⁴. Figure 10 illustrates the extent

²³ <http://www.fao.org/3/w8302e/w8302e05.htm>

²⁴ <https://eic.mn/>

of forest fires in northern Mongolia. The fire damaged areas are shown in red, the extent of forested areas in grey-scale.

The value of forest goods and services obtained from an FAO / UNDP 2013 report estimated this to be on average of 40,000 MNT per hectare²⁵. This equates to a loss of circa 8 billion MNT due to forest fires annually. NEMA themselves estimate that the potential cost of forest fires for the period 2016 to 2025 ranges from US\$ 240 million (63 MNT Billion to US\$ 464 million (123 MNT Billion) at current exchange rates.

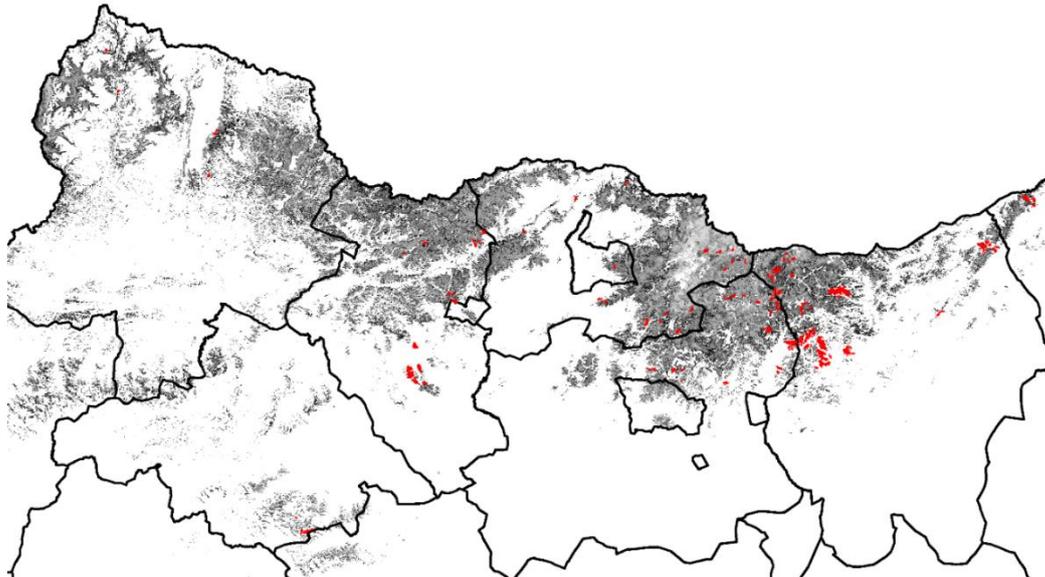


Figure 10 Forest Areas and Fire Extents in Northern Mongolia

²⁵<https://www.mn.undp.org/content/dam/mongolia/Publications/Environment/UNREDD/Mongolia%20Forest%20Sector%20Valuation%20Report%20Final.pdf>

iii) Potential savings

NEMA have evaluated a case study of managing a fire with and without geospatial data and associated GIS for a particularly serious fire in the Matad and Khalkhgol soums in Dornod aimag which occurred in 2015. The main benefits of using the geospatial approach were:

- The ability to more quickly and efficiently deploy staff once the fire was reported.
- Better targeting of resources - less helicopter missions to drop water on the fire were consequently required.
- Earlier warning to people in the area, reduced the risk to human life and crucially, the area lost to productive use was substantially smaller.

The costs without the geospatial capabilities were estimated as 7.3 Bn MNT. In comparison, using the with geospatial the cost was reduced to an estimated 579 million MNT. The savings from having an operational system for this single event were therefore estimated to be in the region of 6.7 Bn MNT. A reduction of 92%.

The logic for translating these statistics into an estimate of the consequent value of an NSDI takes into account the following:

- a) The costs of fully operationalizing the NEMA GIS are included in the investment plan.
- b) The investment already made in establishing the system, has also been included in the cost component of the assessment by including depreciation (based on the total investment (1.3 Billion MNT (US\$5m) over last three years) for first two years of project.
- c) The counterfactual (or second-best approach) would yield between 80% and 90% of the benefits, so only 10% to 20% can be directly attributed to the NSDI.
- d) An online link via an API to the NSDI would be necessary to provide access to the most current data available. This is included in the investment plan.
- e) In the same NEMA report as the case study for Matad and Khalkhgol soums, NEMA projections of the annual costs of forest fires for the period 2016 to 2025 (10 years) are in the range 64 billion – 124 billion MNT.
- f) Taking the case study savings as potentially being high due to the economies of scale for such a large fire, we have used the NEMA case study as the upper bound for savings using a range of 60% to 90% as an average benefit.
- g) For the mean case, the value of economic loss (E) multiplied by the realizable savings (F) and increment above the next best alternative (the counterfactual) (G) produces an estimated attributable savings resulting from NSDI (H).

This calculation used is illustrated in Table 4 below.

Table 4 Disaster Emergency Response Impact on Forest Fires

| Ref | Description | Lower Bound | Mean Case | Upper Bound | Comments |
|-----|--|-------------|-----------|-------------|--|
| E | Economic loss due to forest fires | 64,157 | 94,209 | 124,261 | Calculation: Low case (D1) and High Case (D2). Mean (D1+D2)/2. |
| F | Estimated percentage savings, scaled for average size fire | 60% | 75% | 90% | The case study fire in 2015 benefits from economies of scale as it covered an exceptionally large area it showed a saving with geospatial of 92%. The savings for smaller fires assumed to be less. |
| G | Attributable to NSDI data | 10% | 15% | 20% | The counterfactual (second-best alternative) would be for the NEMA system to use Google maps and OSM data. The estimates of the advantage of more authoritative NSDI data are based on expert opinion from NEMA. |
| H | Realizable savings (in MNT million per annum) | 3,849 | 10,598 | 22,367 | Calculation: E*F*G |

We have used a similar methodology, with data provided by NEMA from 2004 onwards, to calculate annual benefits from other natural disaster response operations where geospatial data is used. The only change to the forest fire methodology is that we have reduced the potential realizable savings to half the amounts used for the forest fire quantification as these have not been modelled by NEMA.

These are summarized in Table 5 below.

Table 5 Weather and Other Natural Disasters Savings

| Ref | Description | Lower Bound | Mean Case | Upper Bound | Comments |
|-----|---|-------------|-----------|-------------|---|
| M | Weather and Other Natural Disaster (Annual Costs) | 40,473 | 40,473 | 40,473 | Absolute figures only supplied i.e., no range. Assumed same for each case |
| N | Scaling to recognize no case studies to justify Geospatial Benefits | 50% | 50% | 50% | Halved as a conservative approach |
| P | Realizable savings (Average size of fire) | 60% | 75% | 90% | The case study fire in 2015 benefits from economies of scale being exceptionally large. The savings for smaller fires will be less significant. |
| Q | Attributable to NSDI data | 10% | 15% | 20% | The counterfactual (second-best alternative) would be for the NEMA system to use Google maps and OSM data. The estimates are based on expert opinion from NEMA itself. |
| R | Annual Estimated Realizable Savings (in MNT million) | 1,214 | 2,277 | 3,643 | Calculation: M*N*P*Q |

5.2.1 Densification of GNSS CORS Network

Use Case

The national mapping agency is proposing within the investment plan for the NSDI to densify the current network of CORS that provide access to accurate geodetic coordinates derived from Global Navigation Satellite System (GNSS)²⁶. Access to these data enable surveyors, engineers, mining companies, utilities and transport users to establish the position of control points for multiple purposes.

Figure 11 shows the geographical distribution of the existing stations (in green) and the additional stations that will be established (in blue).

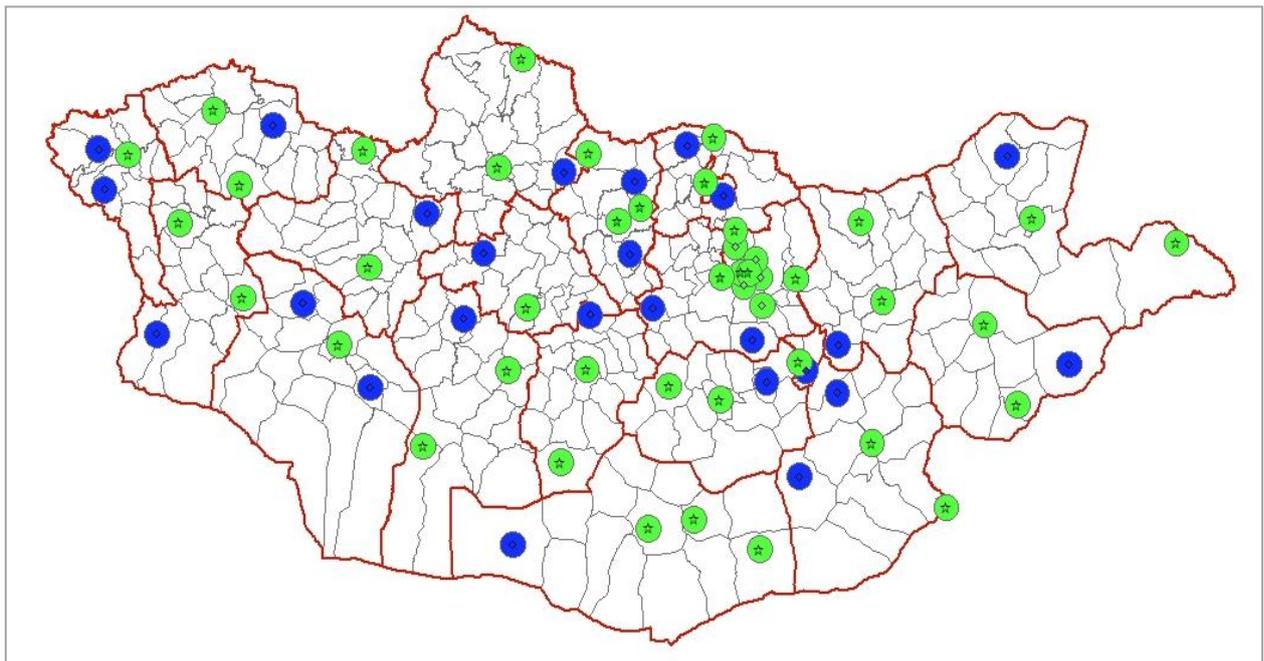


Figure 11 GNSS (CORS) Network Densification Proposal

The greatest economic benefits of this initiative will be derived from:

- Higher levels of accuracy in positioning.
- Faster acquisition of data - tasks that previously took 2-3 hours being reduced to 10s of minutes.
- Less equipment required.
- High reliability where safety is concerned.
- Savings for surveying of between 20% to 40% in labor costs as fewer staff are required.

²⁶ GNSS is the standard generic term for satellite navigation systems that provide autonomous geo-spatial positioning with global coverage. This term includes the GPS (US), GLONASS (Russia), Galileo (European Union), Beidou (China) and other regional systems.

- Savings in costs of between 10% and 20% are also reported from applications of machine guidance and automation in mining and construction.
- Automated mining is reported to deliver overall productivity gains of up to 15 per cent.

Ensuring consistent operation maintenance of (existing) CORS is also essential for not only quick and cost-effective surveys (mobile mapping) as well as for monitoring tectonic and fault movements. Currently, there are 43 CORS in Mongolia operated and maintained by ALAMGC. However, only 28 CORS (45%) are able to deliver RTK data services and 18 CORS (41%) are static data delivery due to both hardware and software being out of date, infrastructure, human resource capacity and running expenses. In order to ensure full-potential use of total 43 CORS, ALAMGC needs to reform their policy, norm and standards, and technology relating GNSS CORS and strengthen human capacity.

A study by ACIL Allen²⁷ undertaken in 2013 in Australia is perhaps the most comprehensive assessment of the economic benefits of augmenting GNSS. Figure 12 summarizes the findings:

Table 5 Increases in sector outputs

| | Low case | High case | Low case | High case | Low case | High case | Low case | High case |
|----------------------------------|------------|------------|------------|------------|----------|-----------|----------|-----------|
| | 2012 | 2012 | 2020 | 2020 | 2012 | 2012 | 2020 | 2020 |
| | \$ million | \$ million | \$ million | \$ million | % | % | % | % |
| Grains | 279 | 434 | 773 | 1,377 | 1.9 | 2.9 | 7.6 | 13.8 |
| Dairy, beef | 18 | 29 | 105 | 791 | 0.1 | 0.2 | 0.4 | 3.3 |
| Other crops including sugar cane | 1 | 2 | 6 | 17 | 0.1 | 0.2 | 0.4 | 1.1 |
| Mining | 682 | 1,084 | 2,437 | 3,134 | 0.4 | 0.7 | 1.1 | 1.4 |
| Construction | 440 | 711 | 1,401 | 2,469 | 0.1 | 0.2 | 0.3 | 0.5 |
| Utilities | 50 | 81 | 173 | 305 | 0.1 | 0.2 | 0.3 | 0.5 |
| Road transport | 96 | 137 | 442 | 752 | 0.2 | 0.3 | 0.6 | 1.1 |
| Transport storage and handling | 58 | 76 | 93 | 164 | 0.1 | 0.1 | 0.1 | 0.2 |
| Rail transport | 1 | 3 | 10 | 12 | 0.0 | 0.0 | 0.1 | 0.1 |
| Aviation | 10 | 18 | 48 | 66 | 0.0 | 0.1 | 0.2 | 0.2 |
| Maritime | 9 | 16 | 41 | 60 | 0.1 | 0.2 | 0.4 | 0.6 |

Note: (1) Surveying is included in the construction and mining sectors.
Data source: ACIL Allen

Figure 12 Sector Output Impacts from GNSS

Quantification Methodology

The impact is calculated using the following logic:

- The Australian study is used as the basis of benefits transfer. The impacts on output of four sectors are most directly relevant to Mongolia, these are shown (using 2020 predictions) in Table 6 Output Impact in MNT for Relevant Sectors.

Table 6 Output Impact in MNT for Relevant Sectors

| Sector | | Low Case | Mean Case | High Case |
|--------|--|----------|-----------|-----------|
| | | | | |

²⁷ The value of augmented GNSS in Australia
<http://www.ignss.org/LinkClick.aspx?fileticket=dKQ6MsXGBAw%3D&tabid=56>

| | MNT million | Impact | MNT million | Impact | MNT million | Impact | MNT million |
|----------------|----------------|--------|----------------|--------|----------------|--------|----------------|
| Mining | 7,604,302 | 1.1% | 83,647 | 1.3% | 95,054 | 1.4% | 106,460 |
| Construction | 1,164,243 | 0.3% | 3,493 | 0.4% | 4,657 | 0.5% | 5,821 |
| Utilities | 682,255 | 0.3% | 2,047 | 0.4% | 2,729 | 0.5% | 3,411 |
| Road Transport | 1,508,252 | 0.3% | 4,525 | 0.7% | 10,558 | 1.1% | 16,591 |
| TOTAL | | | 93,712 | | 112,998 | | 132,283 |

- b) The Government sector is excluded in order to avoid the risk of double counting as the estimated cost of state land registration assumes use of CORS-based GNSS.
- c) The densification will only impact those projects able to access signals from the new CORS. This is estimated on the basis of population distribution and the increase in the density of stations at a province level. The details of derivation of this estimate are not included here but are available in the accompanying cost-benefit spreadsheet. The result is an impact on 15.6% of the projects.
- d) Implementation of the changes in practice that the denser CORS network enables will happen gradually over an assumed period of 10 years.

6. QUANTIFIED ECONOMIC IMPACT RESULTS

In this section the main results of the economic analysis are presented in summary form only, the details of the calculations are contained in a separate accompanying spreadsheet illustrating the base (mean) case and worst and best scenarios.

6.1 Approach

The results of the assessment are presented as a CBA, which is a very mature and widely recognized methodology for appraising large scale investment projects, often involving public spending. The process involves estimating the costs and benefits of a given program to establish whether the outcome at the end of the period of investment and operation represents a satisfactory ROI. The ROI may be compared to other potential investments, facilitating more objective prioritization.

A CBA uses a process referred to as *discounting*, which involves accounting of the rate of interest which could have been earned had the funds used for investment been deposited in an interest-bearing account or other investment. The discount rate must be deducted from the estimated gains from a project, because the funds could have earned interest without incurring the same risk.

Add a statement here about the exchange rate used for conversion between local currency and US\$. This should include basis of exchange rate (e.g., mid-market rate and date).

6.2 Key Financial Variables

The key variables may change according to local conditions and advice from National Central Bank.

The study has used the following parameters:

- Life Cycle – a [xx] year period, consisting of [xx] years of investment followed by [xx] years of operational use. This is commensurate with the infrastructural nature of the investment but takes into account the increasing pace of technological change, so reduces the operational period.
- Discount rate set at [xx%] per annum.
- Inflation is assumed to have an equal effect on costs and benefits and neutral in accounting terms, so inflation effects are not considered in the model.

In addition, other key financial norms, such as any standard project appraisal rules applied by the local Ministry of Finance or Ministry of Economic Development, should be mentioned here.

6.3 Costs

The investment plan is summarized in Table 7.

Table 7 Summary of Investment Profile

| Period | Annual Investment Value US\$ | Cumulative Investment Value US\$ | Investment Value (local currency) | Cumulative Investment Value (local currency) MNT (Million) |
|------------------------|------------------------------|----------------------------------|-----------------------------------|--|
| Year 0+1 ²⁸ | | | | |
| Year 2 | | | | |
| Year 3 | | | | |
| Year 4 | | | | |
| Year 5 | | | | |
| TOTAL | | | | |

A narrative description of the profile of costs for the investment period and the basis of the calculation of on-going costs during the period of operation.

6.4 Summary of Quantified Case Studies

6.4.1 Quantified Benefits

The quantified benefits are summarized in Table 8 below. The rows highlighted in green are direct increases in revenue accruing to Government from improved land and property related tax collection. The principal beneficiaries of those shown in orange are Government Ministries or agencies, whilst the remainder (no color highlights) are indirect benefits.

It represents the mean case. Often described as the “realistic case”, calculated based on average estimate of net benefits where only a range of possible values, can be derived from the available evidence.

The quantified benefits table includes:

- Reference – case study numerical reference.
- Case Study Title – short description of the investment and expected outcome.

²⁸ Year 0 is the term used for investments required during the period before the project starts, these may include for instance, establishing the project management team.

- Evidence – summary of types of evidence sources used in calculation of quantified impact.
- Methodology – the approach to impact calculation
- Benefit recipients – who benefits from the investment – name main recipients - government (name specific department), business (name of sector(s)) or citizens.
- Value – total discounted amounts in local and US\$ currency

A template table with example entries follow

Table 8 Summary of Quantified Benefits

| Ref | Impact | Evidence | Methodology | Benefit Recipients | Net Discounted Value of Benefits \$mil | |
|-----|--|--|---|--------------------|--|-------|
| 1 | National geospatial data sharing (addresses) | Cost estimates and current data duplication | Multiplier effect of information sharing | Govt | | 4.5 |
| 2 | Reduced Loss and Damage during Disasters | Substantial Case Study Expert predictions of reduced costs for future Forest Fires, weather and other natural disasters | Reasoned extrapolation from case study, statistics and expert opinion | Indirect | | 33.2 |
| 3 | Faster emergency response in case of building fires, leading to reduced damage | Statistics supplied by SRO. Global Geospatial Value studies | Reasoned estimation of potential savings, backed by expert opinion. | Indirect | | 5.4 |
| 4 | Increased land use fees and taxes | Current revenues Volumes where premium rates apply | Estimation of proportions of land where premium rates of fees or taxes apply | Revenue | | 26.6 |
| 5 | Increased collection of Property Tax | WB Study in [City Council] | Predictions of increased revenues for City Council | Revenue | | 2.6 |
| 6 | Land Market Growth | Current real estate market size, Comparable study in Bulgaria | Local market analysis, validated by recent comparative study | Indirect | | 3.5 |
| 7 | Urban Planning efficiencies from 3D City Model | In-depth EuroSDR study for Republic of Ireland | Benefits Transfer, validated by local expert opinion | Govt | | 2.6 |
| 8 | Growth in geospatial products and services | Global Economic Value Study for geo-services | Scaled to [Country] and validated based on current size of [Country] ICT market | Indirect | | 6.2 |
| 9 | Open geospatial data value to improving government efficiency | Comparative study of value of geospatial before and after introduction of open data in Denmark | Benefits transfer from Danish study, scaled to [Country] economy | Indirect | | 11.9 |
| 10 | GNSS Densification reducing data acquisition costs | Local expert opinion Australian economic study | Local market intelligence, validated by Australian study | Indirect | | 18.3 |
| | TOTAL US\$ | | | | | 114.7 |

6.4.2 CBA Values

The financial values for the investment plan and on-going recurrent expenditure have been entered into a discounted cash flow spreadsheet to calculate the likely return on Investment using a standard Cost-benefit Analysis approach.

- Benefit – Cost Ratio:
- Net Present Value:
- Optional Limitation Statement: It is important to stress that this assessment is based upon quantification of [xx%] of the identified use cases. If data and time were not constrained, and more case studies had been quantified, it is our expert opinion that the calculated Return on Investment would be significantly higher.

The cash flow forecast is indicated in the chart below (Figure 13).

Add chart extracted from Cost-benefit Analysis to replace example (from Mongolia) below:

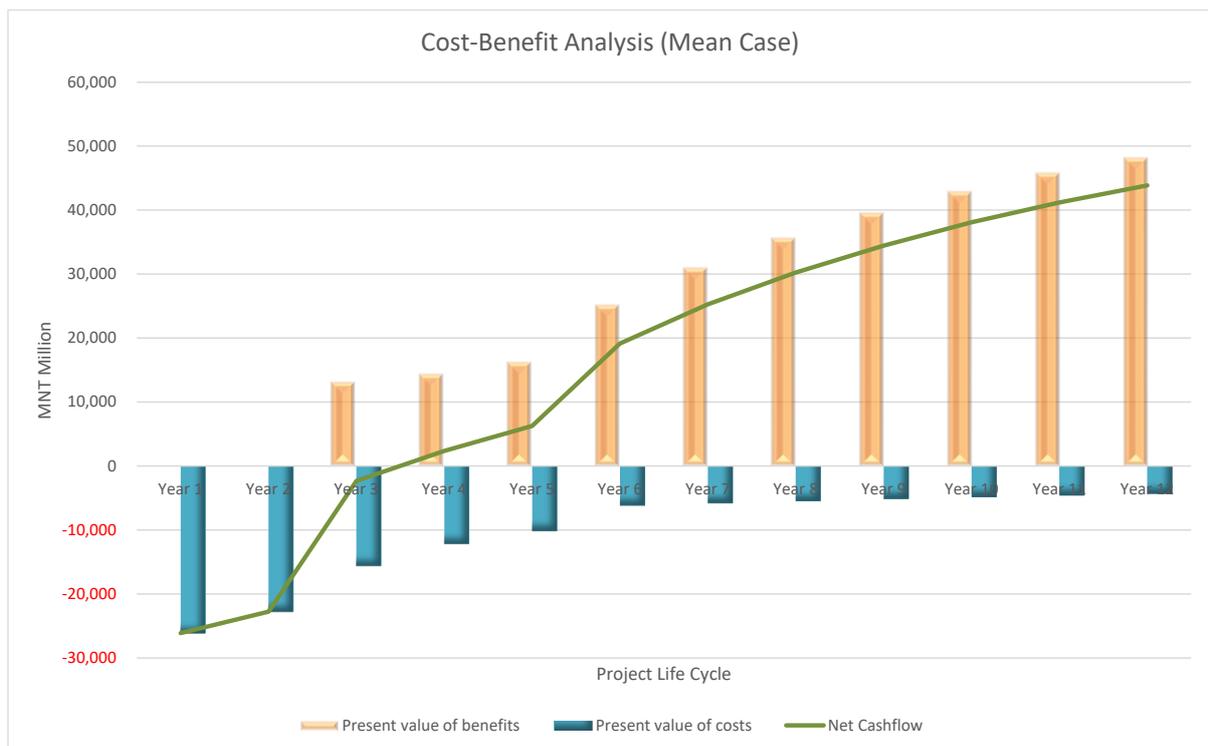


Figure 13 Cost-benefit Forecast (Mean Case)

Add Statement explaining what can be concluded from the chart e.g., impact of quick wins where benefits realized before end of investment period.

6.4.3 Sensitivity Analysis

To assess the robustness of the cost-benefit analysis, sensitivity analysis was conducted by making the following changes to the mean case outlined above:

- i) For the lower bound (most conservative) benefit estimate, low bound impacts were used for all those quantified cases where ranges were available, as follows:

Add use case references and the reasons for reduction to net benefits.

Statement on resulting metrics:

Benefit to Cost Ratio: [xx] (reduction of [xx%] on mean case)

Net Present Value: [xx] (reduction of [xx] on mean case).

- ii) For the upper bound (optimistic case), we have applied the upper bound range of values for the same set of use cases as used in the lower bound.

Add use case references and the reasons for reduction to net benefits.

Statement on resulting metrics:

Benefit to Cost Ratio: [xx] (increase of [xx%] on mean case)

Net Present Value: [xx] (increase of [xx] on mean case).

Statement on conclusion from sensitivity analysis. Optional wording - we conclude that the policy advice that this is viable investment would not change even in the lower bound case.

6.4.4 Risk Management

Reference the guidance from Ministry of Finance (or in absence of guidance, World Bank) regarding risk management. Describe how it has been implemented in your analysis.

Optional Statement: The overarching message in respect to the proposed investment in NSDI is that information is the key resource that is being created and that technological change is unlikely to negate its value but may well enhance it. Further, the mechanisms proposed for curating and updating data are being designed for sustainability.

Table 9 below, outlines the main risks so far identified and suggest how their effects might be mitigated or managed.

Example risk entries shown below:

Table 9 Risk Management Strategy

| Risk | Impact | Probability | Management |
|--|---------------|--------------------|--|
| Lack of buy-in by stakeholders | High | Medium | Strong high-level mandate and agreed governance |
| Expected benefits not realized | High | Low | Tracking of measurable Key Performance Indicators and, if necessary, reallocating investment away from under-performing components |
| Costs overrun | High | Medium | Detailed costing of investments and strong project management |
| Incompatible Technologies | High | Low | Adoption of open interoperability standards, detailed technology assessment prior to implementation. |
| Insufficient human capacity in country to deliver. | Medium | High | Mitigated in short-term by overseas consultancy support, longer term via capacity building programs (Center of Excellence) |

7. NEXT STEPS

7.1 Approval

Statement about the approval process.

7.2. Refine the Investment Plan

The following statements should be included:

Given the nature of the investment and limited time and resources for this analysis, it must be re-stressed that it only currently provides an “order of magnitude” indication of the likely benefits.

If it is necessary to “package” the Action Plan into a series of more detailed business cases for presentation to potential sponsors, then it must be considered that “unbundling” runs the risk that the level of benefits may be reduced on the basis that the “whole is greater than the sum of the parts”.

7.3. Implementation

Include here all advice on implementation not included elsewhere.

7.4. Benefits Realization

Advice on the need to measure benefits throughout the project and adjust investment plans based on performance of each intervention.

More advice on benefits realization is provided in IGIF Strategic Pathway 3 on financial management.

Appendix A: List of Stakeholders

Annex A: Approach to Socio-economic Impact Assessment

Introduction

This document sets out, in an abbreviated and generic form, the process recommended to complete a SEIA²⁹ according to the World Bank IGIF methodology.

Although, other techniques can be adopted it is assumed that the result of this work will be a cost-benefit analysis. The World Bank periodically publishes advice concerning recommended best practice on use of such financial techniques and consultants should ensure they are following the latest advice. However, consultants should also consider current economic conditions and local accepted accounting conventions on key decisions such as discount rates and project life cycle.

The general approach to undertaking SEIA involves the following process:

- Establish scope of use cases to be assessed and the counterfactual³⁰
- Identify the impacts over a defined time-period (project life cycle).
- Where impacts can be creditably quantified, develop cash flows of costs and benefits.
- For non-quantified benefits, document in descriptive (qualitative) terms.
- Discount the quantified cash flows of costs and benefits to calculate Net Present Value, Benefit-Cost Ratio, or Internal Rate of Return, as required by local financial practice.
- Test the sensitivity of the result to variations in costs and benefits.
- Document quantifiable and qualitative results.

Six Step Approach

Breaking down the process is helpful to being able to collect and analyze the information necessary to present a coherent, business case³¹ for investment:

Step 1: Establish Scope and Priorities

The terms of reference, deliverables, timeframes are discussed and agreed with stakeholders. Strategic inputs to the decisions on scope and priorities include consideration of:

- Results of the analysis of the Baseline (Current State) position in respect to SDI development. Under the World Bank methodology this will have been completed

²⁹ The title Socio-economic Impact Assessment, rather than socio-economic benefits assessment, is an acknowledgement that not all impacts will be benefits, there will inevitably be dis-benefits to investment and these need to be included in any assessment.

³⁰ The counterfactual represents the situation that would arise without the identified project.

³¹ A business case provides justification for undertaking a project, program, or portfolio. It evaluates the benefit, cost and risk of alternative options and provides a rationale for the preferred solution. Association for Project Management.

using the Diagnostic Tool (DT) and documented in the Baseline Report. It will help to identify existing investments and their performance in delivering the current SDI.

- Analysis of the GAPD Report. The GAPD is the second stage in the World Bank Methodology that links geospatial use cases to Government policy objectives thus helping to define priorities for future investment.
- National Accounts – a breakdown of the economy to determine which sectors, for example, Agriculture, Manufacturing and Professional Services contribute most to the overall Gross Domestic Product (GDP) of the country. Ideally the contribution of a given sector should be based on its value added to the economy. These are derived from Input / Output tables where available³². This is helpful to evaluate to what extent investment in a sector will have a large impact on economic growth.
- External influences - political, economic, social, technological, legislative, and environmental. Often political pressures will be more important than purely financial outcomes. Understanding these influences will help to draw the optimum balance between competing potential priorities.

The business case approach also needs to be established at this stage and is normally based on how other similar investment projects been prepared for appraisal by Government decision makers in the country being studied.

Experience indicates that the most viable method of arriving at a justifiable assessment, accepted by economists and decision makers, for this type of project is cost-benefit analysis³³. A well established and commonly used technique for financial and economic investment appraisal.

Furthermore, it is recognized that the results achievable in what is usually time constrained research where existing statistical data is likely to be scarce, are likely to represent an “order of magnitude” impact. Consequently, the numbers should be caveated as only indicative of the likely return on investment. A conservative estimation ethos should therefore be adopted to ensure that the results are not overly optimistic, but rather represent a minimum level that could be improved if more time and data were available.

Step 2: Develop Engagement Plan

The study team should draw up a list of key organizations to engage with to gather evidence for the SEIA. This should be derived from interviews conducted in the earlier stages of the World Bank methodology based upon the strength of the use cases for SDI identified at that stage.

³² Where input / output tables are not available, a discussion of value-added substitutes can be found in Eurostat Methodologies and Working Papers NACE Rev.2, published by Eurostat.

³³ A cost-benefit analysis is the process of comparing the projected or estimated costs and benefits (or opportunities) associated with a project decision to determine whether it makes sense from a business perspective to make an investment.

Organizations on both the supply (data producers) and demand (users) side, including commercial sector bodies, should be involved. The primary objective is to identify the most significant quantifiable impacts, principally related to economic growth, increased productivity, and improved citizen outcomes in the various sectors. However, impacts of a more socio-economic nature that are not so easily quantifiable should also be collected through the process. It is often easier for stakeholders to describe the impacts of SDI in qualitative terms, for example how it will improve services to users, before then selecting those that can potentially be quantified.

Briefing sessions should be undertaken to introduce the objectives of the study and approach. In addition, tutorials for stakeholders should also be held to introduce the concepts of socio-economic appraisal and outline the type of evidence that needs to be collected.

Within the selected organizations, suitable individuals with an understanding of geospatial value may have already been identified. If not, then the initial approach to the organization should clearly set out the attributes of suitable interviewees.

For each engagement, the most appropriate type of interaction needs to be assessed. In most cases for the public sector, this is likely to be by face-to-face interviews based on a small set of pre-circulated questions designed to open up discussion. A similar approach is usually adopted for private sector engagement.

A market survey can be an alternative approach for the private sector market engagement. However, bear in mind that it may prove difficult to obtain statistically significant results if the market in each sector is relatively small.

Successful interviewing to elicit quantifiable socio-economic impacts can be challenging. A separate guide to recognized good practice is part of the package of SEIA support materials.

It should be borne in mind that it is rare for quantifiable economic impact information to be fully gathered on a single engagement. Often it is necessary for such information to be assembled (and/or assessed) from several different departments. An on-going dialogue is often required to gain authorization at a senior level, to share financial information and assurances about restrictions on use of such data may need to be documented. The potential for extended duration, due to such causes, needs to be factored into project planning.

Step 3: Collate Base Socio-economic Evidence

Information to underpin the analysis needs to be gathered from various sources, this is often referred to as a literature review:

Existing Geo-economic Studies

An increasing body of evidence of previous socio-economic studies of the value of geospatial infrastructure is available from public sources:

Sector-specific Studies – examining the impact of individual use cases for geospatial information or focusing on a series of use cases across one industry or market sector.

National Studies – although still mostly from developed countries, completed IGIF Action Plans are a growing source of assessments for the developing world. The literature review, in the IGIF good practice guide (Appendix 3.7 Attachment 1) is a useful starting point.

Global Studies – these include reports by economic consultancies commissioned by large corporations and national Governments to assess the total impact of geospatial systems and services. There are also a small number of meta-analyses that look across a range of studies to derive general metrics.

National and Regional Economic Reports

There are many sectoral reports regularly produced for countries and regions by the World Bank, Organization for Economic Co-operation and Development (OECD), United Nations Development Program (UNDP) and United Nations Environment Program (UNEP), for example.

To assist in “triangulating” the assessments of value and refining methodological approaches, studies of economic assessments from other disciplines should also be reviewed, particularly from the domains of digital transformation, transport and environmental management.

Economic Metrics

- i) **Size and Structure of the Economy** (national accounts) – often collected from the National Statistics agency. These provide sector level economic activity by NACE³⁴ codes, the international standard for this type of breakdown.
- ii) **Scaling Factors** – which are required if it is necessary to scale benefits that have been assessed in previous studies in other geographies (see benefits transfer description below). These can be derived from the World Bank’s database of relevant indicators to allow comparison with other countries. The most commonly used factors include:
 - GDP per head of population.
 - Human Development Index.
 - Population size (rural / urban split).
 - Physical characteristics – area, length of coastline, land cover.

³⁴ Statistical Classification of Economic Activities <http://ec.europa.eu/eurostat/web/products-manuals-and-guidelines/-/KS-RA-07-015> (retrieved 2nd April 2021)

Step 4: Analysis

The study team should adopt a standard approach to cost-benefit analysis, as outlined in, amongst other references, the United Kingdom Treasury Green Book³⁵. In essence, this involves:

Identification of costs

The cost side of the business case should consider:

- a) Investment in the development of governance arrangement, capacity development, infrastructure, data standards, legal and regulatory framework, consulting support and data upgrades required by central and local government, but also by the private sector, communities and individuals.
- b) Investment in the promotion and support of use of the SDI by third parties, who will derive and create additional value to the economy.
- c) Operational funding for on-going capacity development, data maintenance, IT maintenance, management and distribution and periodic infrastructure upgrades, amongst other recurrent costs.
- d) Parallel running of different systems during the process of upgrade.
- e) Opportunity costs of not investing.

Identification of benefits

An initial list of all identified benefits by use case and stakeholder will be assembled. Benefits are separated into quantifiable and qualitative, and we will assess them according to likely size of impact and includes any identified drawbacks.

Many different types of benefits may be considered, here we mention some of the most common types identified in developing countries:

- a) Economic Impacts
 - **New Job creation** - from innovative software products and services based on geospatial data.
 - **Increased tax revenues** – based on more accurate and complete knowledge of property locations and values.
 - **Higher agricultural production** – resulting from increased crop yields from using precision farming.
 - **Asset Value Enhancement** – an example would be land market growth due to ability to secure loans based on official recognition of land use rights, such as ownership.
 - **Lower Production costs** – decrease in fuel required to transport people and goods, by reducing traffic congestion and route optimization.

³⁵ Treasury Green book webpage <https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government>

- **Process Efficiency** – removing the need for data duplication through more effective sharing and system interoperability.

b) Social Impacts

- **Faster emergency response** - by Police, Fire and Ambulance services resulting from more complete and authoritative knowledge linking incident reporting to street addresses and points of interest.
- **Discouraging crime** – using geospatial pattern analysis to increase intelligence for police officers enabling prosecution rates to rise.
- **Improved water quality** - through smarter planning of network extensions to serve more citizens and lowering costs of pipe maintenance.
- **Reduced numbers of Land and Property-related Court Cases** - by increasing the accuracy of cadastral parcel and immovable property data.
- **Helping Public Health** – improving methods of tracking the spread of diseases such as COVID-19.
- **Supporting decentralization** – by developing tools that help better informed and more localized decision making.

c) Environmental Impacts

- **More sustainable Urban Development Planning** - using 3D city models to allow decision makers and the public to better visualize the impact of building projects.
- **Climate Change Adaption** - from improved flood prediction using more accurate hydrological modelling.
- **Preventing Land Degradation** - by using satellite imagery to monitor deforestation.
- **Reducing air pollution** - by allowing location-referenced crowd sourced data to pinpoint the causes.
- **Calculation of Quantifiable Benefits**

- Two principal methods are used:

Primary evidence: used for those benefits where the evidence is directly derived from interviews during the engagement.

Secondary evidence: often referred to as benefits transfer, involves scaling impacts to the national level from case studies in other geographies with strong provenance, based upon metrics such as population, area and GDP.

Step 5: Construct Financial Model

The model assumptions should cover:

- **Life Cycle** – typically a 12-year period is adopted, consisting of 5 years implementation of the SDI program followed by 7 years of use. This is commensurate with the long-term infrastructural nature of this type of investment.

- **Discount rate** - in the absence of more specific local advice, a “rule of thumb” is to use a figure of 3% above Central Bank base rate. SDI investment is normally considered a relatively low risk endeavor, relying as it does on well-proven GIS technology and leveraging good practice from other geographies, through adopting IGIF guidance.
- **Inflation** – it is normal practice for the effects of inflation to be ignored since they can be expected to affect both costs and benefits equally. However, if there are specific components of either that are established to be more sensitive to such changes, then this should be explicitly justified in the analysis.

From the information detailed above, a discounted cash flow model should be created and populated. The key assessment criteria for the result would be a simple Benefit to Cost Ratio (BCR) or Cumulative Net Present Value (NPV).

In some cases, it may be appropriate to calculate an Internal Rate of Return. This is the discount rate that equates the present value of benefits with the present value of costs. Internal Rate of Return (IRR) assume that all cash surpluses from project can be invested at the IRR and all project financing can be sourced at the IRR. For high IRRs (say greater than 20 per cent) this is not likely to be the case. In such circumstances the other alternative measures are more meaningful.

To support risk assessment, a sensitivity analysis should be built into the model by varying the value of key factors where the range of potential values, from worst to best case, was largest.

Step 6: Report

The final stage of the process is to create a narrative based upon the information gathering and analysis, together with the results. A recommended structure for the report is as follows:

- Executive Summary
- Introduction – background and overview of country
- Scope – the identified potential “entry points”
- Methodology – options, choice, and assumptions
- Literature Review – relevant economic benefit studies
- Analysis – primary cases and benefits transfer choices
- Results – calculation of costs and benefits
- Conclusions and Next Steps

A range of communication products (presentations, blogs, social media posts and videos) may also be required to socialize the results with different stakeholder groups from politicians to economists to technical experts and to the public.

End of Document